Journal of the Society of Arts.

FRIDAY, NOVEMBER 27, 1857.

NOTICE TO MEMBERS.

The Council hereby convene a Special General Meeting of the Members of this Society, to be held on Tuesday, the 1st of December, at 7 o'clock, p.m., for the following purposes:—

1. To revoke the five existing Bye-laws which relate to the Board of Examiners, and to make and adopt other Bye-laws in the place thereof.

2. To consider the amended and extended scheme of Examinations which the Council propose to carry out in concert with the Institutions in union.

3. In compliance with a requisition received from certain members, "to take into consideration and decide on the propriety of continuing to hold Local Examinations of the Members of Mechanics' Institutions and similar societies, and to award certificates of merit accordingly."

4. And, generally, to pass such resolutions as may express the sense of the meeting in relation to all or any of the before-mentioned subjects.

By order of the Council,
P. LE NEVE FOSTER, Secretary.
Society's House, Adelphi, London, Nov. 23, 1857.

EXAMINATIONS FOR 1858.*

NOTICE TO THE INSTITUTES.

1. In 1856 the Society's Examinations were held in London alone. In 1857 they were held in London and Huddersfield.

2. In 1858, and thenceforward, it is proposed to hold them simultaneously at all places, throughout the whole extent of the Union, where suitable arrangements can be made by the authorities of the Institutes.

3. The Society of Arts cannot satisfactorily hold oral examinations, simultaneously, in many places. The Society's Examinations, therefore, will in future be wholly by papers.

4. The Council invite the Institutions in union to assume in future a larger share of authority and responsibility in the management of the Examinations.

5. Bearing in mind that the Union of Institutions was formed for the purpose, not of superseding, but of promoting and supplementing, the action and self-government of those bodies, the Council propose the following scheme of

Previous } Examinations by the { Local Authorities.
Final } Examinations by the { Society of Arts.

* The Programme with the subjects of Examination may now be had of Messrs. Bell and Dalby, 186, Fleet-street, publishers to the Society of Arts.

PREVIOUS EXAMINATION BY LOCAL BOARDS.

6. The Institutes in different parts of the Union are invited to appoint Local Boards, who will conduct the previous Examinations of their own Candidates, and also supervise the working of the papers which the Society's Board will set for the Society's Final Examinations.

7. No Candidate can be admitted to the Final Examinations without a Certificate from his Local Board, that he has satisfactorily "passed" its previous Examination (*a*) in the elementary subjects specified in par. 10, 11, 12, 13, and (*b*) in the special subjects in which he wishes to be examined by the Society's Board.

8. The previous Examinations must be held twelve weeks before Whitsuntide.

9. Unreserved communications between the Society and the Local Boards will be requisite to secure to the "passes" of the various Local Boards throughout the Union such an uniformity of value as may be attainable; and it is hoped that their standard may be raised, carefully and gradually, from year to year, in order that the scope and authority of those bodies may be constantly on the increase.

10. The previous Examinations of the Local Boards will test the handwriting and spelling of the Candidates, their knowledge of English grammar, composition, and the common rules of arithmetic, as well as their knowledge of those special subjects in which they seek to be examined by the Society's Board of Examiners.

11. HANDWRITING.—A bold even round-hand, without loops, longtails, or flourishes, should be preferred.

12. ENGLISH GRAMMAR AND COMPOSITION.—An extract from some standard English author may be set, into which errors of spelling, grammar, and punctuation are introduced. Some faulty grammatical constructions in common use, and vulgarisms, may be submitted for correction.

13. ARITHMETIC.—A knowledge of the elementary Rules, including the Rule of Three, should be required.

FINAL EXAMINATION BY THE SOCIETY'S BOARD OF EXAMINERS.

14. The names of the "passed" candidates, and the subjects in which the Society is to examine them, must be made known to the Council eight weeks before Whitsuntide.*

15. The Society's Examiners will then set the papers for the final Examination; and these will be forwarded to Local Boards. The Local Boards will see, and certify to the Council, that the papers are fairly worked, by each Candidate, without copying from any other, and without

* The required number of forms for this purpose will be forwarded to the Local Board on application to the Secretary of the Society of Arts.

books or other assistance; and will return the worked papers to the Council.

16. No person who shall not have been, for six months previously, a member of an Institution in union with this Society; no person under sixteen years of age; no graduate or undergraduate of any university of the United Kingdom; no student of any of the learned professions; no certificated schoolmaster or pupil-teacher; and no person who has not satisfactorily "passed" the previous Examination of the Local Board, is eligible for examination by the Society's Examiners.

17. No Candidate will be examined in more than three subjects.

18. The Examinations will be conducted by printed papers. Every paper will, in general, be divided into two sections; an easier, and a more difficult one. Satisfactory answering in the former will entitle a Candidate to a Certificate of Competency. The Examiners will award Certificates of three grades, but Certificates of the first grade will be awarded only to a high degree of excellence.

19. The Final Examinations of the Society of Arts will be held on Whit Monday, the 24th of May, 1858, and on such successive days as may be requisite, simultaneously at such places, throughout the Union, as can make satisfactory arrangements for the previous Examinations of the Local Boards, and for the supervision of the working of the papers in the final Examinations of the Society's Board.

20. Judgment will then be passed by the Society's Board of Examiners, and the Awards, Prizes, and Certificates will be communicated to the parties concerned.

21. The Prizes and first-class Certificates will be awarded at some local centre of importance. The Council will afford some aid to the travelling expenses of the candidates who may desire to come up and receive their Certificates.

ASSOCIATES IN ARTS OF OXFORD AND CAMBRIDGE.

22. The Council have read with the greatest satisfaction the Statute, recently published by the University of Oxford, for examining and granting the title of "*Associate in Arts of Oxford*" to young persons not of the University. Cambridge is happily following this excellent example.

The Examinations are to be annual, independent of any denominational test, and open to all youths under 18 years of age.

With the view of assisting to bring the proposed titles of "Associate in Arts of Oxford," and "Associate in Arts of Cambridge," within the reach of the members of Institutes in union with this Society, the Council will grant to each youth, not less than 16 or more than 18 years of age, who shall obtain, in 1858, three of the Society's Certificates of the first class in the subjects contained in the Oxford and Cambridge programmes, the sum of £5 towards his expenses, if he attends at the University and undergoes the Examination there.

By order of the Council of the Society of Arts.

P. LE NEVE FOSTER, *Secretary.*

Nov. 23, 1857.

SECOND ORDINARY MEETING.

WEDNESDAY, NOV. 25, 1857.

The Second Ordinary Meeting of the One Hundred and Fourth Session, was held on Wednesday, the 25th inst., Dr. Lyon Playfair, C.B., F.R.S., in the chair.

The following Candidates were balloted for and duly elected members of the Society:—

Burley, Benjamin	White, William Foster,
Haywood, Fred. Michael	F.R.G.S., F.G.S., &c.

The Paper read was:—

ON THE COMPOSITION AND RELATIVE VALUE OF THE FOOD GRAINS OF INDIA.

BY J. FORBES WATSON, A.M., M.D., BOMBAY ARMY.

Before proceeding to consider the composition and relative value of the more important of the food grains of India, a few preliminary remarks will be necessary; and, first, I have to state that the researches on which the following observations are chiefly founded, have been conducted under orders received from the Court of Directors of the East India Company, with the object of illustrating the nutritive value of the principal division of the food resources of our Indian Empire.

The details, chiefly chemical, connected with this investigation will be fully discussed elsewhere, and, therefore, in the meantime, I confine myself to those points which, from their dietetic and commercial relations, seem of chief interest.

Viewed with reference to sound social and political conditions, the quality and amount of the vegetable food substances which a given country furnishes, or can furnish, is pre-eminently of vital importance, and to no country more so than to India, in which the vast bulk of the means of subsistence of 176,000,000 of inhabitants is directly gathered from the soil. Every country has its vegetable products, differing much in value and nutritive quality; and to improve the state of agriculture, to increase the productive powers of the soil, and to bring the food grains of the rich within reach of the poor man's purse, is, in other terms, to increase human happiness, to advance civilization, and to plant deep the roots of a sound national wealth. As Dr. Royle has forcibly pointed out, the slightest enlargement in the size of a grain, or the least increase in the productiveness of an ear of corn, when extended into the agriculture of a country, will infinitely increase its resources and revenues. The advancement of agriculture is, for every reason, then, the interest of the state, and in addition to the welfare of its people, and the condition of its finances, the question has other deep connections. England has had her bread riots, and France is not the only empire in the world's history whose political existence of the hour has hung upon her heads of corn.

So far, then, with reference to the importance of agriculture to the state, and to the direct relations of the cultivator to the soil.

Experience has, to a certain extent, taught man the relative nutritive power of the food products around him. Market value, indeed, usually stamps this. Still the researches into this subject during the last 10 or 15 years, which have shed a broad light on many points formerly obscure, can be brought to bear in the most important way on many questions which affect the interests of the people and of Government. The productions of India are as numerous as its surface is diversified and its climate various, and a glance at these tables will show that its food grains in point of number alone occupy no unimportant position. These, with a few exceptions, are cultivated (in, however, very varied quantities) throughout the whole of India, and form the staple food of the mass of the population. In the plains of Upper India, to the west, in Guzerat and Scinde, wheat is extensively cultivated, and in the north, along with barley, constitutes the common food of the people, whereas in the south, wheat for the most part is a luxury which the poor man cannot reach. Thus, also, rice at the deltas, and by the sides of large rivers, is the chief food of the million, but pass inland some distance, and it in its turn has become available only to the rich.

Here the poor man sighs for the "Chowl" (rice) of the river level, and looks with less favour on his staple millet, which experience in some places has, however, shown, and science in these tables demonstrates, to be in some respects superior to rice; and thus in given cases chemistry may confirm experience, and settle certain conclusions on a firmer basis.

A mixed diet has been declared essential for man, and this, the grain-fed inhabitant of the East, carries into practice in a sense as strict as when we add flesh to bread and vegetables. The food grains of India present the usual grand divisions into cereals and pulses, and under these heads are arranged the various classes of grains used as food for man and beast. First, then, on the list of cereals stands wheat, which, *par excellence*, may be considered the grain in which almost the requisite balance exists between the nitrogenous or flesh-forming constituents, and the non-nitrogenous or heat-yielding and fat-forming elements, and, indeed, wheat-flour may be taken as the standard by which to compare the relations between the nutritive components of other grains. Bread will, under ordinary conditions, support the system for a longer period than any other compound, and it is possible that, were man less a "cooking animal," it would do so under conditions demanding more than ordinary muscular exercise. Bread and water does, however, present but little variety to the palate, and it is well known that with, as far as we at present know, the plastic and carbonaceous elements in proper proportion, the human system demands change, and that *sameness* alone will in time produce that somewhat enigmatical disease, scurvy. The relations between the nitrogenous and non-nitrogenous constituents of our Indian and English wheats, as seen in the Table No. 3, is as 8·6 of the latter to one of the former, and, allowing a proportion for the extra quanitity of nitrogen which the bran of the whole meal contains, about 6·6 may be taken as the relation which exists between these important constituents in wheat flour; that is to say, that a compound consisting of from six to six and a-half pounds of non-nitrogenous to one of nitrogenous matter, contains these in the proportions required by the human body under ordinary conditions. Suppose, then, that six non-nitrogenous to one nitrogenous represent the proportions in which the system demands these elements to exist, and we have at once a standard by which to measure the nutritive value of other grains, and a reference to the table will show that almost all the others on the list either fall considerably short of, or go beyond, the point thus fixed. Take rice, for instance, and let us illustrate this as well as some other points of interest. In rice it will be observed that the proportion of carbonaceous matter, such as fat and starch, to albuminous compound, is, in some cases, twice as much as it is in wheat, and that on the average it amounts to ten and a-half of the former to one of the latter, instead of six, which we have assumed to be about the proper amount. The native of India would consequently have to eat twice as much of rice as he would of flour in order to obtain the requisite amount of nourishment, and to supply the never-ceasing wear that is constantly going on in the human body.

The popular notion is that rice forms the entire bulk of the diet of almost all the inhabitants of the East, and those, even on the spot, who, with vision unopposed by superfluous clothing, have seen a thin lanky Cooly sit down to his evening meal, and have watched the gradual development that has attended his operations, might feel disposed to coincide in this, but, nevertheless, it is not a fact that the native of India lives on rice. Rice, when he can afford it, certainly does form the bulk of his food, but, as a rule, viewing the population as a whole, it is the food of the rich. The stomach of the poor ryot, large as it is, could not with impunity take in and digest the quantity of rice which would be required to supply the sanguigenous or blood-forming wants of his system, and accordingly nature's promptings have led him to add one or other of the numerous pulses shown in Table 2, in quantity sufficient to supply to the starchy rice the requisite amount of nitrogen, containing, as many of them do, nearly twice as much of that essential element as wheat.

There are, of course, other articles of diet, non-vegetal, which, according to caste, that incubus of India, various classes are permitted to employ, such as eggs, fish, and flesh of certain animals, &c., which must be considered in order to afford a comprehensive view of dietetics in India; but for the present I must confine my observations strictly to the relative nutritive value of these grains, two or more of which conjoined constitute the entire bulk of the solid food eaten by the Brahminical or strict vegetable-eating class.

We see, then, from the fact just mentioned, that experience has taught the native of India to combine these grains, so as to secure a true mixed food in the nutritive sense of the word. As a rule, to his rice he adds from one-fourth to a fifth of some leguminous seed, his favourite one being the *Cajanus indicus*, of which some analyses stand out in Table 2.

These pulses accordingly occupy a most important position in the food catalogue of the country; they are, in fact, to the Brahmin what beef and other fleshes are to us, and their importance now and then receives a sad illustration when their failure as a crop obliges the ryot to have recourse entirely to rice or some of the less nutritious millets.

On the existence, then, of these pulses, or on a supply of animal food, depends, with few exceptions—of which wheat, barley, and oats constitute the chief and almost only ones—the relation which ought to exist between the blood and flesh-forming and heat or fat-yielding elements in a given diet.

A detailed statement of the special results which these tables indicate will be presently given, but before proceeding to do so, a few other remarks on nutritive value will not be out of place, and in making these I may, perhaps, be excused if I repeat one or two things already cursorily touched upon.

At the head, then, of the list of cereals stands wheat, which, as already mentioned, is held, in itself, to contain, in proper proportion, all the elements necessary for the support of animal life, which in the form of bread or cooked flour, at the same time, probably, also affords the bulk which is requisite to the constitution of a suitable diet, and, for this reason, it can be taken for a longer period than fat flesh, which, in a concentrated form, also contains the essential elements in proper proportion.

Experiments, then, with bread have shown that, under ordinary conditions, it will support the system for a period so long that it may be fairly argued that, when it

FOOD GRAINS OF INDIA.

Table I.—CEREALS.

COMPOSITION PER 100 lbs. IN NATURAL OR FRESH STATE.

	DESCRIPTION.			COMPOSITION.									
	NAMES.			ORGANIC.						MINERAL.			
	Common.	Botanical.	Date and Place of Growth, or Market whence obtained.	Moisture.	Nitrogenous Matter, Gluten, Albumen, &c.	Fatty Matter.	Starchy Matter.	Total Non-nitrogenous Matter.	Proportion of Non-nitrogenous to 1 Nitrogenous.	Phosphorus.	Sulphur.	Total Mineral Matter (Ash).	REMARKS.
	WHEAT.												
1	Wheat, Gehoow Kunak...	Triticum vulgare, &c.	Broach Zilla, 1854	12·40	15·62	1·16	68·74	69·90	4·47	·365	·058	1·98	Employed almost solely as food for man, and as a rule eaten by only the richer classes.
2	,, ...	,, ,,	Bombay Bazaar, 1856...	12·80	13·16	1·05	71·73	72·78	5·53	·371	·067	1·26	
3	,, ...	,, ,,	Guzerat, 1857	13·81	13·05	1·36	70·14	71·50	5·47	·373	·064	1·64	
4	,, ...	,, ,,	Bombay, 1857	13·41	12·84	1·17	70·99	72·16	5·52	·337	·057	1·59	
5	,, ...	,, ,,	Guzerat, 1855-6	10·90	13·23	1·29	73·28	74·57	5·63	—	—	1·30	
6	,, Red variety	,, ,,	Bombay Bazaar, 1857...	13·32	14·80	1·14	68·64	69·78	4·71	—	—	2·10	
7	,, ...	,, ,,	Madras, 1856.............	10·86	12·72	1·03	73·77	74·80	5·79	—	—	1·68	
8	,, ...	,, ,,	Calcutta, 1856	11·78	11·34	1·01	73·97	74·98	6·67	—	—	1·90	
			Mean......................	12·40	13·34	1·15	71·41	72·56	5·60	·362	·062	1·68	
	BARLEY (without Husk).												
9	Barley, Gow.................	Hordeum hexastichon	Bombay Bazaar, 1857...	12·56	14·19	2·58	68·81	71·39	5·03	—	—	1·86	Eaten by man.
10	,, ,, ...	,, ,,	Nepaul, 1850..............	12·90	11·56	1·24	72·30	73·54	6·36	·441	·059	2·00	
			Mean	12·73	12·88	1·91	70 56	72·47	5·20	·441	·059	1·93	
	BARLEY (with Husk).												
11	,, ,, ...	,, ,,	Bombay Bazaar, 1856	—	—	—	—	—	—	—	—	—	For Beasts.
	OATS.												
12	Oats, mixed sample......	Avena sativa	Jata and Moonghyr...	13·52	10·20	3·62	68·72	72·34	7·09	—	—	3·94	Introduced for horses.
	MAIZE OR INDIAN CORN.												
13	Maize, Mukka	Zea mays	Bombay Bazaar, 1856...	13·54	9·89	1·63	73·07	74·70	7·55	—	—	1·87	Eaten chiefly by man.
14	,, ,, ...	,, ,, ...	Do. do. 1857...	12·26	8·32	1·55	76·40	77·95	9·37	—	—	1·47	
			Mean......................	12·90	9·10	1·59	74·74	76·33	8·46			1.67	
	MILLETS (Husk Removed).												
15	Millet, Tipsee Gooruroo		Bengal	11·78	8·60	4·16	74·18	78·34	9·11			1·28	In state used by man.
16													
17													
			Mean......................										
	DITTO (with Husk).												
18	Bajra	Penicillaria spicata...	Bombay, 1856	9·82	10·73	3·03	74·46	77·49	7·22	—	—	1·96	Ground whole for [bread.
19	,, ...	,,	Bellary, Madras	12·40	10·08	2·20	73·42	75·62	7·50	·367	·042	1·90	,, ,,
20	Great Millet, Joar Jowaree..........................	Sorghum vulgare	Bombay Bazaar, 1856...	12·00	9·64	2·15	74·58	76·73	7·96	—	·040	1·6[illegible]	,, ,,
21	Great Millet, white variety	,,	Patna, Bengal	12·70	9·20	1·91	74·49	76·40	8·30	·393	·045	1·70	,, ,,
22	Wuree—Khang	Panicum miliare	Bellary, Madras	11·80	10·41	2·02	71·77	73 79	7·69	·328	·056	4·00	
23	Bajra	Penicillaria spicata ..	Narespore, 1856	11·80	10·13	4·62	71·35	75·97	7·48	·260	·042	2·10	,, ,,
24	Tipsee, Gooruroo	Panicum spicata	Bengal	12 80	7·98	4·52	71·90	76·42	9·85	·298	·033	2·80	
25	Natchnee, Naglee	Eleusine coracana ..	Bombay, 1856	11·16	5·68	·52	80·00	80·52	14·17	—	—	2·64	Used mostly in famine [seasons.
			Mean..	11·81	9·23	2·62	73·99	76·6[illegible]	8·70	·329	·043	2·34	
	RICES.												
26	Rice, Chanwul, Bansmutti	Oryza sativa.	Bareilly, Bengal, 1854 .	12·80	8·44	·64	77·62	78·26	9·27	·132	·026	·50	
27	Rice, British-cleaned	,,	Carolina (Lond. 1857) .	12·16	8·07	·64	78·47	79·11	9·80	—	—	·66	
28	,, ,, ...	,,	Java (Lond. 1857)	13·14	7·76	·83	77·92	78·75	10·15	—	—	·35	
29	,, ,, ...	,,	Pegu, 1854	13·50	7·49	·40	78·01	78·41	10·47	·124	·041	·60	
30	,, Pulut	,,	Malacca, 1850	12·90	7·21	·60	78·59	79·19	10·98	·155	·037	·70	Considered a delicacy.
31	,, ,, ...	,,	Broach, Bombay, 1854 .	13·10	7·18	·48	78·64	79·12	11·02	·133	·029	·60	
32	,, Bansmutti	,,	Bombay Bazaar, 1856...	11·60	7·14	·63	79·88	80·51	11·12	—	—	·66	
33	,, Best Puja	,,	Bombay Bazaar, 1856...	12·10	6·96	·60	79·86	80·46	11·56	—	—	·48	
34	,, ,, ...	,,	Patna (Lond. Mar. 1857)	12·86	7·87	·44	78·34	78·78	10·01	—	—	·55	
35	,, ,, ...	,,	Arracan (Lond. 1857) .	13·24	6·48	·56	19·24	79 80	12·31	—	—	·48	
36	,, Red variety...........	,,	Bombay Bazaar, 1857 ...	13·00	7·43	·71	77·62	78·33	10·54	—	—	1·24	
			Mean	12·76	7·45	·59	78·56	79 16	10·66	·134	·033	·62	

TABLE I. (CONTINUED.)

STARCHES.

37	Arrowroot	Maranta arundinacea	Rutnagerry, Bombay	15·18	·71	·69	75·90	76·56	107·89	—	—	1·14	
38	Sago	Sagus rumphii	Sumatra, 1850	14·40	·56	·58	84·26	84·84	151·50	·041	·003	·20	
39	Arrowroot	Maranta arundinacea	Rutnagerry, Bomb. 1850	17·80	·53	1·22	79·87	81·09	155·00	·161	·007	·58	
40	Curcuma Starch, "Tikor"	Curcuma leucorrhiza	Rohilchund	16·30	·48	·91	80·81	81 72	170·27	·126	·007	1·50	
41	Arrowroot	Maranta arundinacea	Cannanore, 1853	16·00	·38	·65	82·51	83·16	218·84	—	—	·46	
			Mean	15·94	0 53	0·81	78·67	81·47	160·68	0·109	0·006	0·7[illegible]	
	MISCELLANEOUS PRODUCTS.												
42	Plantain Meal	Musa paradisiaca	Madras	13·10	4·27	1·17	78·26	79·43	18·00	0·159	0·010	3·20	Fruit dried and ground.
43	Sago meal from pith of sago palm	Phœnix farinifera		—	—	—	—	—	—	—	—	—	

TABLE II.—PULSES.

COMPOSITION PER 100 LBS. IN NATURAL OR FRESH STATE.

	DESCRIPTION.			COMPOSITION.									
	NAMES.			ORGANIC.						MINERAL.			
	Common.	Botanical.	Date and Place of Growth, or Market whence obtained.	Moisture.	Nitrogenous Matter, Gluten, Albumen, &c.	Fatty Matter.	Starch, &c.	Total Non-nitrogenous Matter.	Proportion of Non-nitrogenous to 1 Nitrogenous.	Phosphorus.	Sulphur.	Total Mineral Matter (Ash).	REMARKS.
	PEAS, PISUM SATIVUM (WITHOUT HUSK).												
44	Peas, Wattanah, Gol muttur.	Pisum sativum	Benares, 1850	11·28	28·20	1·12	56·82	57·94	2·05	—	—	2·58	
45	Peas, Wattanah	,, ,,	Bombay, 1856-7	12·30	27·72	1·82	55·78	57·60	2·08	—	—	2·38	
			Mean	11·79	27·96	1·47	56·30	57·77	2·07			2·4[illegible]	
	DITTO (WITH HUSK).												
46	Indian Vetch, Soora Kesaree	Lathyrus sativus	Calcutta vicinity, 1850	10·10	31·88	·88	54·64	55·5[illegible]	1·74	·465	·045	3·20	
47	Peas (No. 45, with husk).	Pisum sativum	Bombay do. 1856-7	12·01	25·01	1·73	58·67	60·40	2·01	—	—	2·56	
48	Do. (No. 44, with husk).	,, ,,	Benares do. 1850	12·70	25·59	1·21	58·00	59 21	2 31	·323	·058	2·54	
49	Do. white variety	,, ,,	Do. do. do.	12·60	21 97	1·12	62·01	63·13	2·87	·269	·062	2·30	
			Mean	11·86	26·11	1·24	58·33	59·56	2·33	·352	·055	2·64	
	FAVOURITE PEA, CAJANUS INDICUS, (WITHOUT HUSK) (CALLED "DHOLL").												
50	Toor, Urhur, (Toor Dholl)	Cajanus indicus	Jaffrabad, Bombay, 185[illegible]	10·08	22·99	1·21	62·66	63·87	2 78	—	—	3·06	
51	,, ,, ,,	,, ,,	Bombay Bazaar, 1856	9·80	23·79	1·51	61·60	63·11	2·65	—	—	3·30	
52	,, ,, ,,	,, ,,	,, ,,	9·15	23·30	3·74	61·80	65·54	2·94	—	—	3·01	Rubbed with a little oil—a common practice.
53	,, ,, ,,	,, ,,	Palamcottah	11·80	21·75	1·44	61·71	63·15	2 90	—	—	3·30	
54	,, ,, ,,	,, ,,	Broach, 1855	12·30	20·09	1·86	75·15	77·01	3·83	·292	·082	2·90	
			Mean	10·63	22·18	1·95	68·96	70·91	3·03	·292	·082	3·11	
	DITTO (WITH HUSK).												
55	Toor, Urhur (whole)	Cajanus indicus	Calcutta Bazaar, 1850	12·80	23·87	1·54	58·39	59·93	2·51	·358	·054	3·40	
56	,, (No. 50, with husk on)	,, ,,	Jaffrebad, Bombay, 1853	9·74	20·97	1·04	65·73	66·77	3·13	—	—	3·32	
57	,, (No. 43, ,,)	,, ,,	Palamcottah	11·8[illegible]	19·37	1·60	63·73	65·3[illegible]	3·38	·425	·056	3·50	
			Mean	12·4	21·4	1·37	62·62	64·0	3·01	·392	·055	3·41	
	LENTIL ERVUM LENS (WITHOUT HUSK) ("DHOLL").												
58	Mussoor, ("Dholl" from)	Ervum lens	Bombay Bazaar, 1857	13·60	25·71	1·29	58·40	59·69	2·32	—	—	1·00	Not eaten by very strict Hindoos, on account of its *red* blood-looking colour.
59	,, ,,	,, ,,	Calcutta, 1854	11·40	26 03	1·00	59·57	60·57	2·32	·337	·054	2·00	
60	,, ,,	,, ,,	Bombay, 1856	10·96	25·31	1·76	59·77	61·53	2·43	—	—	2·22	
61	,, ,,	,, ,,	Candeish, Bombay, 1857	10·40	23·49	·99	61·64	62·63	2·66	—	—	2·48	
			Mean	11·84	25·15	1·26	59·85	61·11	2·43	·337	·054	1·92	
	DITTO (WITH HUSK).												
62	Mussoor No. 60, with husk	Ervum lens ,,	Bombay Bazaar, 1856	10·72	25·04	1·90	60·15	62·05	2·47	—	—	2·19	
63	,, (whole)	,, ,,	Calcutta	12·70	24·88	1·02	59·10	60·12	2·41	·332	·046	2·30	
			Mean	11·7	24·96	1·46	59·63	61·09	2·44	·332	·046	2·2[illegible]	

TABLE II. (Continued.)

"GRAM-DHOLL," CICER ARIETINUM, without Husk.

64	"Chick Pea," Gram [chenna	Cicer arietinum	Bombay Bazaar, 1857...	13·38	30·07	1·23	53·58	54·81	1·82	—	—	2·34	In this state is largely used as an article of food.
65	,, "Gram" Doll (Gogaree)	,, ,, ...	,, ,, 1856...	9·75	23·16	3·77	60·77	64·54	2·78	—	—	2·55	
66	,, ,, ,,	,, ,, ...	,, ,, 1856...	9·07	22·38	4·52	61·42	65·94	2·94	—	—	2·61	
67	,, ,, ,,	,, ,, ...	,, ,, 1857...	12·06	21·48	4·28	71·82	76·10	3·54	—	—	2·42	
68	,, (Jumboosary)	,, ,, ...	,, ,, 1856...	11·40	20·98	3·78	62·04	65·82	3·13	—	—	2·80	
69	,, ,, ...	,, ,, ...	Madras, 1850	11·30	21·04	4·31	60·45	64·76	3·07	·538	·104	2·90	
70	,, New. Ghatie	,, ,, ...	Bombay, 1857	12·76	19·78	4·47	60·41	64·88	3·28			2·60	
			Mean	11·39	22·70	3·76	63·18	67·09	2·94	·538	·104	2·60	

DITTO (with Husk).

71	Chick No.68, with husk on	Cicer arietinum	Bombay, 1856	10·80	20·97	3·37	61·96	65·33	3.11	·360	·099	2·90	Chief article of food for horses; quantity, from 5 to 6 lbs. per day.
72	"White Gram," Caboolee, Chuna	,, ,,	Saharumpore, 1854......	12·20	20·65	4·63	59·72	64·35	3·11	·406	·042	2·80	
73	Gram Gogaree, No. 65, with husk	,, ,,	Bombay, 1856	9·25	17·98	4·06	66·33	70·39	3·91	—	—	2·38	
74	Gram	,, ,,	Madras, 1850	10·40	21·32	4·46	60·42	64·88	3·04	·461	·107	3·40	
75	,, ...	,, ,,	Bengal, 1850	11·20	19·51	4·66	61·83	64·49	3·40	·336	·127	2·80	
76	,, Gogaree, No. 67, with husk	,, ,,	Bombay, 1856	12·48	18·08	4·41	61·81	66·22	3·66	—	—	3·22	
77	,, ...	,, ,,	Benares, 1850	12·00	17·79	5·10	62·31	67·41	3·79	·318	·031	2·80	
78	,, No.70, with husk on	,, ,,	Bombay, 1857	12·26	17·25	4·46	62·21	66·67	3·62	—	—	3·82	
			Mean.........................	11·32	19·19	4·39	62·07	66·47	3·45	·380	·081	3·01	

BEANS (DOLICHOS SPECIES) (without Husk).

79	Wall	Dolichos spicatus......	Bombay, 1857	11·00	23·06	2·09	60·50	62·59	2·71	—	—	3·35	Favourite bean with Hindoos, &c.
80	"Ghot Wall," large variety	,, ...	,, 1853	12·02	21·04	2·19	60·89	63·08	2·86	—	—	2·86	
81	Chowlee	,, sinensis	,, 1857	13·12	24·44	2·33	56·75	59·08	2·41	—	—	3·36	
			Mean..............	12·03	23·27	2·20	59·38	61·58	2·66			3·19	

DITTO (with Husk).

82	Guwar	Dolichos fabœformis.											Most of these are cooked whole with the husk on.
83	Cooltee	,, uniflorus ..	Bombay, 1856	11·3	24·44	·51	60·40	60·91	2·49	—	—	3·35	
84	Wall	,, spicatus.....	,, 1856	10·8	24·57	·79	60·82	63·60	2·96	—	—	3·02	
85	Chowlee	,, sinensis ...	,, 1856	12·4	24·19	·86	79·41	60·27	2·48	·417	·043	3·14	
86		,, ...	Bellary, Madras, 1859..	11·5	22·54	·77	62·34	63·11	2·80	·262	·050	2·85	
87	Chowlee	,, sinensis ...	Calcutta, 1854	13·2	22·37	·98	60·45	61·43	2·74	·464	·042	3·00	
88	"Pa da Lout"	,, ...	Pegu, 1853................	13·4	20·54	2·09	60·17	62·26	3·03	·446	—	3·80	
			Mean.........................	12·2	24·06	1·09	61·95	63·17	2·60	·397	·045	3·18	

BEANS (PHASEOLÆ) (without Husk).

89	Ooreed, Moog "doll" Mash	Phaseolus mungo ...	Bombay, 1857	11·98	25·64	1·61	57·54	59·15	2·30	—	—	3·23	In state used by man.
90	,, ,, ,,	,, ,, ...	Bellary, Madras, 1850...	12·90	23·81	1·11	59·98	61·09	2·56	·461	·054	3·10	
			Mean	12·44	24·73	1·36	58·76	60·12	2·43	·461	·054	3·17	

DITTO (with Husk).

91	Muht	Phaseolus aconitifolius	Calcutta, 1850	12·4	24·52	·61	58·67	59·28	2·41	·368	·051	3·80	The most of these are used for beasts as well as man. They are not so highly esteemed as the others.
92	Ooreed, Mash	,, mungo......	Benares, 1850	12·5	24·03	·72	59·65	60·87	2·50	·430	·034	3·10	
93	,, ...	,, ,, ...	Bombay, 1857	9·2	24·45	1·44	61·66	63·10	2·58	—	·135	3·26	
94		,, (noleniivery Rox.)..........	Bengal, ...	11·8	24·06	·76	59·78	60·54	2·51	·349	·073	3·60	
95	Sona Moog	Phaseolus aurens ...	Calcutta, ...	11·4	17·32	2·10	65·48	67·58	3·91	·404	·050	3·70	
96		,, ...	Madras, ...	12·1	23·12	·88	60·80	61·68	2·66	·370	—	3·10	
97	Muht	P. aconitifolius	Bombay, 1857		23·31	·67	—	—	—	—	—	3·41	
98			Bombay, 1856	11·0	22·49	·48	63·12	63·60	2·82	—	·055	2·91	
99	Moog	P. mungo	Bellary, Madras, 1850...	12·1	21·61	2·06	61·13	63·19	2·83	·476	·060	3·10	
			Mean	12·8	21·65	1·08	61·28	62·48	2·78	·399	0·65	3·44	

MISCELLANEOUS PULSES (without Husk).

100	Bhoot	Soja hispida	Benares, 1850	9·74	46·32	12·41	28·43	40·84	0·88	—	—	3·10	
101	Catjang Tahoo		Sumatra, 1850	10·76	41·29	17·64	24·87	42·51	1·03	—	—	5·44	
102	Catjang Egow		,, 1850	—	28·85	1·65	—	—	—	—	—	3·87	
			Mean.........................	10·25	38·83	10·56	26·65	41·68	0·96			4·14	

DITTO (with Husk).

103	Bhoot, No.100, with husk	Soja hispida	Benares, 1850	10·4	43·86	12·51	28·33	40·84	0·90	·803	·077	4·9	Said to be the source of the "Soy" sauce.
104	Catjang Tahoo	,, ,,	Sumatra, 1850	11·3	39·39	17·75	26·26	44·0	1·11	·607	·121	5·3	
105	Catjang Egow	,, ,,	,, 1850	12·0	27·33	1·15	56·02	57·17	2·09	·485	·021	3·5	
106	Pa Yan	,, ,,	Pegu, 1850	12·6	23·52	·89	59·88	59·88	2·54	·479	·119	4·0	

Note.—The "Nitrogenous Matter" is obtained by multiplying the actual quantity of nitrogen found by 6·3.

FOOD GRAINS OF INDIA.

TABLE III.—(MEAN COMPOSITION PER 100 LBS.)

1. CEREALS.

NAMES.		ON SAMPLE WITH HUSK REMOVED. (Eaten chiefly by Man.)										ON SAMPLE OF WHOLE GRAIN. (Eaten by Animals, and occasionally by Man.)										NOTES AND REMARKS.
		ORGANIC.						MINERAL.				ORGANIC.						MINERAL.				
COMMON.	BOTANICAL.	Water.	Nitrogenous Matter, Gluten, Albumen, &c.	Fatty Matter.	Starchy Matter.	Total Non-nitrogenous Matter.	Proportion of Non-nitrogenous to 1 of Nitrogenous Matter.	Phosphorus.	Sulphur.	Total Mineral Matter (Ash).		Water.	Nitrogenous Matter, Gluten, Albumen, &c.	Fatty Matter.	Starchy Matter.	Total Non-nitrogenous Matter.	Proportion of Non-nitrogenous to 1 of Nitrogenous Matter	Phosphorus.	Sulphur.	Total Mineral Matter (Ash).		
Wheat, Indian	Triticum vulgare	—	—	—	—	—	—	—	—	—		12·40	13·34	1·15	71·41	72·56	5·60	0·362	0·062	1·68		
„ European	„ „	—	—	—	—	—	—	—	—	—		15·00	12·28	1·50	68·52	70·02	5·70	0·372	—	1·70		
Barley, Indian	Hordeum hexastichon	12·73	12·88	1·91	70·56	72·47	5·20	0·441	0·059	1·93		—	—	—	—	—	—	—	—	—		
„ European	„ „	—	—	—	—	—	—	—	—	—		14·00	10·08	2·30	69·42	71·72	7·11	0·307	—	2·20		
Oats, Indian	Avena sativa	—	—	—	—	—	—	—	—	—		13·52	10·20	3·62	68·72	72·34	7·09	—	—	3·94		
„ European	„ „	—	—	—	—	—	—	—	—	—		16·00	13·86	5·00	64·14	69·14	4·98	0·253	—	3·00		
Maize, Indian	Zea mays	—	—	—	—	—	—	—	—	—		12·90	9·10	1·59	74·74	76·33	8·46	—	—	1·67		
„ European & American	„ „	—	—	—	—	—	—	—	—	—		12·00	11·02	—	69·63	75·63	6·86	—	—	1·35		
Millets, Indian...	(Various species)	11·78	8·60	4·16	74·18	78·34	9·11	—	—	1·28		11·81	9·23	2·62	73·99	76·62	8·70	0·329	0·043	2·34		
Rice, Indian	Oryza sativa	12·67	7·45	0·59	78·56	79·16	10·66	0·134	0·033	0·62		—	—	—	—	—	—	—	—	—		
„ other observers	„ „	13·00	6·93	0·50	76·87	77·37	11·16	—	—	0·70		—	—	—	—	—	—	—	—	—		
Starches, Indian	(Various)	15·94	0·53	0·81	78·67	81·47	160·68	0·109	0·006	0·78		—	—	—	—	—	—	—	—	—		
Sago-meal, Indian	Phœnix farinifera											—	—	—	—	—	—	—	—	—		
Plantain-meal, Indian	Musa paradisiaca	13·10	4·27	1·17	78·26	79·43	18·00	0·159	0·010	3·20		—	—	—	—	—	—	—	—	—		Fruit dried and ground.

2. PULSES.

COMMON.	BOTANICAL.	Water.	Nitrogenous Matter, Gluten, Albumen, &c.	Fatty Matter.	Starchy Matter.	Total Non-nitrogenous Matter.	Proportion of Non-nitrogenous to 1 of Nitrogenous Matter.	Phosphorus.	Sulphur.	Total Mineral Matter (Ash).	Water.	Nitrogenous Matter, Gluten, Albumen, &c.	Fatty Matter.	Starchy Matter.	Total Non-nitrogenous Matter.	Proportion of Non-nitrogenous to 1 of Nitrogenous Matter	Phosphorus.	Sulphur.	Total Mineral Matter (Ash).	NOTES AND REMARKS.
Peas, Indian	Pisum sativum	11·79	27·96	1·47	56·30	57·77	2·07	—	—	2·48	11·86	26·11	1·24	58·33	59·56	2·33	0·352	0·055	2·64	
„ „	Cajanus Indicus	10·63	22·18	1·95	68·96	70·91	3·03	0·292	0·082	3·11	12·43	21·40	1·37	62·62	64·01	3·01	0·392	0·055	3·41	Favorite pea.
„ English		—	—	—	—	—	—	—	—	—	—	23·31	2·00	57·39	59·39	2·54	0·342	0·040	2·30	
Lentils, Indian...	Ervum lens	11·84	25·15	1·26	59·85	61·11	2·43	0·337	0·054	1·92	11·71	24·96	1·46	59·63	61·09	2·44	0·332	0·046	2·25	
„ English		—	—	—	—	—	—	—	—	—	—	26·77	2·25	55·98	58·23	2·14	—	—	3·00	
Grams, Indian	Cicer arietinum	11·39	22·70	3·76	63·18	67·09	2·94	0·538	0·104	2·60	11·32	19·19	4·39	62·07	66·47	3·45	0·380	0·081	3·01	Chief food for Horses, in state of "dholl" used largely by Man.
Beans, „	Dolichos	12·03	23·27	2·20	59·38	61·58	2·66	—		3·19	12·2	24·06	1·09	61·95	63·17	2·6	0·397	0·045	3·18	
„ „	Phaseolus	12·44	24·73	1·36	58·76	60·12	2·43	0·461	0·054	3·17	12·8	21·65	1·08	61·28	62·48	2·78	0·399	0·065	3·44	
„ „	Soja hispida	9·74	46·32	12·41	28·43	40·84	0·88	—	—	3·10	10·40	43·86	12·51	28·33	40·84	0·90	0·803	0·077	4·90	
„ English		—	—	—	—	—	—	—	—	—	—	25·20	2·00	54·00	56·00	2·22	0·395	0·032	2·80	
"Catjang Tahoo"		10·76	41·29	17·64	24·87	42·51	1·03	—	—	5·44	11·30	39·39	17·75	26·26	44·01	1·11	0·607	0·121	5·30	

does cease to do so, it is not because it lacks in well-balanced nutritive power, but because the palate and stomach have become, as it were, wearied; for variety is essential to every dietary that aims at preserving health intact for any length of time.

And, indeed, wheaten bread has been taken by Liebig, the greatest authority of the day, as a proper standard to guide us in the due admixture of the ingredients that, in their sum total, do constitute a suitable diet, and he adds, "that in choosing the various articles of his diet, man is directed by an unerring instinct, which rests on a law of nature, and which prescribes to man, as well as to animals, a proportion between the plastic and non-nitrogenous constituents of his whole diet," and he adds, "it is the elevated mission of science to bring this law home to our minds; it is her duty to show why man and animals require such an admixture in the constituents of their food for the support of the vital functions." One great object in dietetics, then, is to find out the sum that will best express these proportions. "Man's unerring instinct," when left to itself, certainly does lead him, as forcibly illustrated by Dr. Letheby, in his late paper before this Society, to combine, as his means will permit, various articles, so as to ensure a proper balance between essential elements. Still, governments and corporations require the aid of science to decide such points; for one apparently trifling omission in the construction of a dietary, for either soldiers or prisoners, may be the means of depriving the state of most valuable lives, as well as, unwarrantably, of very useless ones. And this, indeed, constitutes an argument for investigations into the food resources of a country, such as that carried out by the East India Company, for such tabular statements place at the disposal of the commissariat officer as well as of the civilian, the means of introducing, with advantage, other than routine articles, should the supply of these be defective.

But to return to the important question, as to what should be considered the proportion that ought to exist between the plastic blood or flesh-forming, and the carbonaceous heat or fat-yielding constituents of a given diet, or, as I shall consider it, grain, for before the comparative nutritive value of the various cereals or pulses shown in these tables can be decided, the standard of measurement must be fixed. The question then is, have we amongst these grains themselves one which will itself furnish this? We have shown the reasons for believing that the flour of wheat contains in proper proportion the elements required to support for a considerable period, the powers of life, and it consequently follows that an investigation into the constitution of wheat is likely to furnish the standard sought for. It will be observed that in wheat the mean of my own experiments places the proportion of non-nitrogenous, or carbonaceous, to one of nitrogenous or plastic, as about five and a-half (5·6) of the former to one of the latter; but as these analyses have been made on the whole grain, the husk or bran of which contains a good deal more nitrogen than the fine flour, six and a-half, although a little under the relative quantity of the above ingredients, shewn by the latest and most trustworthy analyses of bread and fine flour, may be, perhaps, the proper standard. But seeing that experiments with bread fail if much labour be done, suppose that the nitrogenous matter in the fine flour is rather defective in amount, and that the whole meal, which gives rather more than five and a-half (5·6) supplies the proportional factor required; or, seeing that ordinary wheat flour seems to be possessed of almost sufficient power, divide the difference, and adopt 6 parts non-nitrogenous to one nitrogenous, as the statement of the relation that ought to exist between these, and for the present this is what we shall take. And this leads me to make a few remarks on what has been laid down as the true index of nutritive value. It will be observed that what we have been searching for is the number that expresses the proportion that ought to exist between two essential elements in every food, and it is not assumed that nature has insisted on one of these being more important than the other, or that the human system can permit either to be defective. Both the nitrogenous and non-nitrogenous compounds we hold to be of equal moment, for a definite relationship has evidently been established between them; the destruction of which inevitably leads to decay and disease. As far as the welfare of the human body is concerned, there is, perhaps, no element, not adventitious, that can be held to be of more use than another. The importance of plastic material to yield blood and muscle, and of the carbonaceous to supply the heat and fat, stands out in striking relief, but to the vital wants of the system these are not more important than is the fraction of iron in food which enters into the composition of the blood, and to the essentiality of which, if defective in amount, the blanched lip and quivering heart soon testify.

It has been held, that nutritive power is in exact proportion to the amount of plastic or nitrogenous element, and this rule has accordingly been applied to the various alimentary substances used by man.

As already mentioned, whole meal from wheat contains about one per cent. more of nitrogenous matter than fine flour, and, therefore, applying the rule just indicated, it would follow that bread made of the former would be more nutritious than that from the latter, and, indeed, the poor man has been looked upon as somewhat *dogged*, in not having sooner availed himself of the fact which science is assumed to have laid at his feet. But experience has brought even the hard working navvy to a different conclusion. Bulk for bulk, he finds that the fine flour enables him better than the coarse to support the tear and wear of daily toil. Let us admit, however, that this, to a great extent, arises from its physical condition. The labourer finds that the brown bread does not remain long enough to get, as he calls it, the "good of it." The rough brany particles cause a certain amount of irritation, and thus the coarse bread passes too rapidly through the system, and affords too large a residue of that, the removal of which at this moment constitutes a question materially affecting the welfare of the two and a half millions aggregated in this huge metropolis.

The experience of the labourer thus practically nullifies the conclusions of the chemist, as to the nutritive power of the substance we have been considering; but it may be held that if nature had only made bran more soluble and a little less irritating, it would, from its large per centage of nitrogenous element, be an admirable article of food. Condition, whether affecting raw or cooked substances, must ever be kept in view in drawing practical conclusions as to the amount of benefit the human system will derive from given articles of diet, and we shall, therefore, suppose that this has had to do with the failure which attends the use of brown bread by the working man. But we have a very numerous class of substances largely used for food, viz., the pulses, to which, when husked and ground into meal, the objection that holds goods with regard to the "whole meal" of wheat, will not apply.

In our Indian pulses the proportion of non-nitrogenous and nitrogenous compounds, as shown in these tables, varies from a little more than two up to about three of the former to one of the latter, instead of the five and a-half, as in the case of wheat, or six and a-half in that of fine flour or bread; and there is one bean—the *Soja hispida*—in which I have found the proportion between these elements to have the relation of less than one of plastic to the unit of carbonaceous matter; and which, consequently, if the theory is sound which holds that nutritive value is in proportion to the nitrogen contained, would, in power, exceed that of flesh itself.

To the decision of this point experience again comes to our aid, and her conclusions cannot here be rejected for the same reason as in the case of bran, for neither the eye nor the microscope can detect the rough irritating

particles such as are found in bran or brown bread. Take animals, then, and feed them on beans and lentils, which, according to the theory we have been considering, stand amongst vegetable substances at the head of the list, in assumed nutritive power, and what occurs? The health of animals confined to such, for any length of time, deteriorates, and the same takes place in the case of man, even if too large a proportion of peas has entered into his diet. And the results of the (in the very best sense of the word) truly national experiments that year after year are being carried on at Rothamstead, lead to the conclusion that, practically considered, the theory that assigns to different substances a value in proportion to their nitrogenous compounds, is fallacious; and the far greater demand for cereal than leguminous grains to supply the wants of man and animals, certainly shows, from a very broad point of view, the decision to which nature has come on this subject.

Man or other animals when under the influence of hard labour can, however, take in and assimilate a considerably larger quantity of such highly nitrogenised substances; but observation and physiology lead to the conclusion that under such circumstances they require a proportionably larger quantity of carbonaceous matter, and, as Lawes and Gilbert have pointed out, the system of the labourer undergoing more than usual bodily exertion, seems in practice to call for substances containing even more than the ordinary proportion of carbonaceous matter. And even in tropical India, where a disinclination for much fat is likely to exist, it has been found essential to add extra "ghee" or butter to the diet of the prisoners undergoing manual labour. Extra labour does demand an increased supply of nitrogen in the food, but at the same time it probably necessitates a more than proportionately larger quantity of carbon. The soldier who in darkness and silence works, literally, for life in the out-lined trench, wastes fast his straining muscles, and new flesh-particles, or the elements for forming them must be supplied in his food—but it is not the muscle alone that wears out. Muscular exertion involves accelerated respiratory movement and increased cutaneous transpiration, and through the million outlets presented by the lungs and skin, the oxidised carbon streams with rapidity, and probably in amount proportionately in excess of the extra nitrogenous compounds which have resulted from spent muscle-element. Admit, then, that extra labour involves a demand for the plastic and carbonaceous elements of food even in proportions relatively equal, and it logically follows that, adopting the grounds on which the nitrogen theory itself has been formed, the carbonaceous compounds are of as much moment to even the sons of toil as the nitrogenous, or if our suggestion be correct, they hold the more important position of the two.

We find that instinct, through generation upon generation, has led man to form certain dietetic combinations, the component parts of which have a tolerably definite relation to each other, and it is our object to endeavour to ascertain the proportions which nature shows ought to exist between the various elements that in their sum total constitute a proper food for man. That once laid down we have the key to the chief position; but even then an essential element may be wanting, and here it is that the labours of the chemist are brought to bear with advantage. It has been shown that nature has led man to combine the ingredients of his food in unison with the requirements of his system, which, beyond a certain point, seem to vary in accordance with demands made by climate, labour, &c., upon his power. We likewise hold that however these may be increased, the proportionality existing between the demand for essential ingredients in all probability remains much the same, and from this it follows that, having discovered the relation that ought to exist between the essentials in a given food, the next thing is to accumulate information as to the amount of these elements, so as to admit of proper mixtures or combinations being made. This is the information which the chemist can afford, and that which these tables are intended to illustrate. The problem, then, is the relation which exists between the essential constituents of a given grain or mixture of grains—which ensures a diet that will support and give vigour to the human frame. Wheat grain in itself seems to present us with the proper proportions, and from considerations already stated, we, for the present, have assumed six of carbonaceous to one of nitrogenous compound as about what should be taken. In addition to this, we have almost the same conclusion arrived at by another route. Founded upon their own and Dr. Lyon Playfair's elaborate calculations, Lawes and Gilbert, by the examination of eighty-three different dietaries, have inferred that a little above five-and-a-half represents the proportion of non-nitrogenous to one of nitrogenous substance, which may fairly be taken as representing the relation between these important constituents. In these the actual proportional number is 5.52, but as this has been calculated on the assumption that starch chiefly existed in these dietaries, and as these all contained a certain proportion of fat, which, if calculated up to its equivalent of starch as a standard, would give a higher proportion of non-nitrogenous to nitrogenous than that stated, it consequently follows that the number which I have adopted will probably come not far from the wished-for point, and even it may be found to be under rather than above the mark. This, then, will constitute what we conceive to be the test of nutritive value, and I trust I shall be excused the time which I have occupied in discussing this part of the subject: for before entering upon the question of relative nutritive value it was essential to lay down and illustrate the principles which have been applied in working out the number referred to. Given, then, 6 to 1 as the proportion between the carbonaceous and nitrogenous compounds, as indicated by the human system, and it follows that in diet or food articles, any quantity (within the limits of error in the calculation) above or below the point thus fixed, will be, by so much, in the true sense of the word, less nutritious, and from this it logically results that, whereas millets and rice are so, from the excess of carbonaceous, over the standard proportion, pulses are less valuable as sole articles of food, for an exactly opposite reason—the excess of nitrogenous diminishing the required amount of carbonaceous; and, consequently, those pulses will prove of most value that contain the least proportion of nitrogen; and it will be presently shown that the two pulses of the East most in favour and most largely used, are exactly those that come nearest to our standard, in consequence of containing a smaller quantity of nitrogenous compounds than the others. The *Cajanus indicus*, in the husked state called "Doll," is eaten in preference to any other, and a common habit with regard to even it, bears out the argument. It is the almost universal custom to prepare this pulse, for edible use, by rubbing it with a little oil, by which means the proportion of the carbonaceous over the nitrogeneous is increased. No. 52 in the pulse table, represents an analysis of "*Toor doll*" bought in the Bombay bazaar, and which had previously been thus treated, and it will be seen that the average proportion of fat or oil in it has been increased from about 1½lbs. per 100 to 3¾lbs. per ditto, and that the nitrogenous matter has been proportionally diminished by such treatment, and, as before pointed out, if the carbon in this extra quantity were calculated as such, it would give a proportion of that substance 2¼ times greater than starch does, and would, by so much, diminish, still further, the proportion of nitrogen to elemental carbon, and bring the substance itself, as an article of diet, still nearer to the standard I have fixed, and, if eaten alone, ensure a proportionately lesser quantity being consumed with impunity, or for a longer time, without detriment to the system: thus affording another example of the manner in which nature

leads man artificially to ensure a proper relation between the constituent elements of his food.

So much for this part of the question. Our standard of comparison now fixed, we are in a position to consider, with advantage, not only these grains, but every diet, however compound. I hope to have the opportunity, on another occasion, of treating at large on the subject of the food of the natives of India, with reference to quality, and, as far as can be ascertained, the quantity also, but for the present I shall confine myself to a statement of the composition of these grains, and of the relation which exists between the amount of principal constituents in these, leaving for another period and place the discussion of the relationship between certain other important elements, which involve details more strictly chemical than those likely to interest the general public.

First, however, before examining these tabular statements which contain in detail the information with regard to these grains, I wish to lay before the public a few remarks on the more prominent points presented by the agriculture of India, which will not here be out of place. The value and pre eminent importance to India of its agricultural products, may be stated in a sentence. According to returns before me, the total value of the agricultural products exported from India in 1853 amounted to £17,484,133, representing more than four-fifths of the then entire value (£21,519,861) of Indian commerce. Of this sum, £889,040 is laid down as that received for the grain products of the soil. Viewing this statement as a whole, it has, with reason, been said that the greatness of India in the world's estimation depends on her agriculture, and that for her future prosperity and progress, reliance can alone be placed on the improved cultivation of her soil, and on the facilities that may be afforded to enable her to bring her products to the best markets, whether in or without the country, at the lowest possible expense.

With regard to the actual cultivation of the soil itself. Considered generally, this is not yet in a satisfactory condition, although considerable efforts on the part of Government have been made to improve it; and Dr. Royle's late work on cotton shows the exertions already devoted to the development of an article of such paramount importance to this country. A good deal of valuable information bearing on cultivation, as practised in the widely separated districts of India, exists, which it would be interesting to give a summary of, but for the present I must content myself with briefly stating that in some points the cultivator in India is not so far behind his European brother as is generally believed. The rotation of crops has been known and practised for ages, and even the rude-looking implements which they employ, viewed with reference to the power at command, the state of the soil, and the means of the ryot, are well adapted to attain the end in view. And in this, as in some other matters, it would be well if attention were directed to the improvement of what has been, and is found, to suit the circumstances presented by an Indian soil and climate, rather than to attempt to supersede these by the introduction of the actual implements employed in this country.

We shall proceed now to the consideration of the composition of the grain products themselves. In the tables placed before the meeting, these will be found to be classified under the usual heads of cereals and pulses, and at the bottom of the cereal table another, denominated "starches," is placed as that substance enters almost entirely into the composition of the articles indicated, and in addition there is at the bottom of both tables a few substances which I have placed there, either from their peculiarity, or from, in one or two instances, the difficulty experienced in classifying them. With regard to the specimens employed for analysis. Upwards of forty of these were furnished me by Dr. Royle, from the new and most important museum of industrial products, rapidly being brought to completion at the India House. These embrace samples of all the important species of grain cultivated in India; but as the date of growth of many of these goes as far back as 1850, as a check I procured fresh samples from Bombay—some overland within the last three months—and these, in number nearly fifty, have also been subjected to analysis. And I may mention that the two larger tables, 1 and 2, are intended to serve as an index catalogue to the composition of the samples in the bottles on the table.

In an undertaking of this sort it was essential to obtain assistants, whose chemical knowledge and practical skill were worthy of the importance and extent of the undertaking, and it is at once a pleasure and a duty to state my obligations to the zeal and ability brought to my aid during the whole of this investigation by Mr. Frederick Manning and Mr. Wentworth Scott, and for shorter periods by Mr. W. Valentine and Mr. Frank Fowler. To Mr. Manning's experience of upwards of eight years in the Rothamstead laboratory, I am indebted for the admirable and extensive series of estimations on which the principal part of the organic division shown in these tables depends; and it is also due to Mr. Scott to mention that the practical details connected with the mineral department have chiefly been carried out by him.

It will be observed that in drawing out these tables, two chief divisions have been adopted, depending on whether the sample of grain was operated upon whole, or with the husk removed, the last giving the state in which, as a rule, the article is employed for human food. The next two principal divisions are into "organic" and "mineral," and the divisions of these, again, are seen in the tables.

The importance of the constituents, stated under the organic division, at once strikes the mind, but, if time permitted, it would not be difficult to still further illustrate what I have already briefly indicated, viz., that, viewed with reference to the essential wants of the system, and to effects produced upon it, the organic is not, in this point of view, of more importance than the mineral. Of the mineral constituents, the phosphorus, sulphur, and iron are the elements that have chiefly received attention. The contents of the central column within the heavy lines, showing the proportion of non-nitrogenous to one of nitrogenous is that which will, however, chiefly for the present occupy our attention, as, if the arguments brought forward in this paper be correct, that it is which affords the indication of true nutritive value.

At the head of the list of cereals stands wheat, the great food-grain of this and other European countries, and one which in Central India, and to the north, as well as almost to the sea-side in Guzerat, occupies a prominent position in the agriculture of the country. Of Indian wheats, as shown in Table I., eight samples from various districts through India have been submitted to analysis, with the general result of showing a composition fully more identical with that of the wheats of Europe than is generally supposed to be the case. For the statements in Table III., which, under these analyses of the several species of Indian grains, shows the average composition of a number of European wheats, &c., I am indebted to Dr. Gilbert, who has calculated these as the mean from a great number of analyses; but as these embrace the results of one large series of analyses, which all late observations show to be too high, it is quite probable that a fresh investigation of these European wheats would show that they contained fully a less proportion of nitrogen than even that shown in the table. It will be observed that every 100 lbs. of these European wheats contain 15 lbs. of water, whereas the Indian ones have only about 12 and a-half pounds. It consequently follows that a given weight of Indian wheat will contain more nutriment than the same quantity of European, because there is more water in the latter than in the former;

although, if we drive off the whole of the moisture from both, and make the quantity, in either case, up to 100 lbs., it will have the effect of showing a slightly larger proportion of nitrogeneous matter in the European, than even that shown in the table. In the average statement, shown in Table III., it will be observed that the proportion of non-nitrogenous to nitrogenous, is within four-tenths of the standard 6 to 1, which nature has apparently settled to be the relation demanded by the requirements of the system. Upon this showing, the *whole* grain of wheat would require to have a proportion of starchy or fatty element added, in order to dilute or bring it down to the true proportion,—a thing, by another mode, accomplished by the sieve separating the more highly nitrogenous bran from the flour.

With regard to practical qualities, arising from the physical condition of the grains themselves, a word may be said, as it bears on the question of the suitability of Indian grain for the markets of England, a point which Dr. Royle has fully discussed. The Indian are, as a rule, what are called "hard wheats," in which the outer portions, consisting of a very dense substance, are difficult to reduce to fine flour—indeed, proving so detrimental to the mill-stones themselves, that our millers reject them for this cause alone. But the whole question of the practicability of the introduction, at a suitable profit, of Indian wheat into our European markets, supposing,—which appears to be the case—that the original cost in India and the expense of freight to this country would permit of this, is, for the present, settled by the weevil, a small insect, specimens of which, I dare say, can be detected amongst these samples, although some have in order to destroy them, been subjected to nearly the heat of boiling water. The destructive powers of these little creatures, from their numbers, are enormous. Many of the cargoes of wheat attempted to be introduced into this country have been thus all but completely spoiled, and our grain merchants are naturally very loth to admit even partially damaged cargoes into their granaries. These insects are not destroyed by any amount of heat which can practically be applied to wheat in the mass. Cold seems the only means by which they can be removed. With regard to the value in our market here of Indian wheat, I have submitted the samples on the table in Mark-lane, and have found that on an average. cargoes of these would fetch from 35s. to 40s. A cargo of No. 97 was brought from Madras, and cost here 36s. per quarter. It weighs the full weight of 62 lbs. per bushel—is in pretty fair condition, and is now being employed to add "strength," as it is called, to some soft wheat, the two being mixed in certain proportions. So much for wheat. Next on the list stands barley. This is much used in Northern India, and constitutes a chief article of food in many districts. One of the specimens on the table is from Nepaul and very fine. It will be observed that Table III. shows the mean composition to represent the existence of a smaller proportion of carbonaceous matter to nitrogenous than wheat does, and that, as an article of food, according to the mode proposed of indicating nutritive value, it would require to be diluted, as it were, by the addition of a larger proportion of carbonaceous matter than the whole meal of wheat does. Compared with European barley, it will be observed to contain upwards of two per cent. more of nitrogenous matter.

With regard to oats little need be said. A number of years ago, the *Avena sativa*, the common oat of this country, was introduced by some European gentlemen as food for their horses, and around Patna and in Moonghyr it is now cultivated in some quantities, but not being a stock article I have only submitted one sample to analysis. It looks poor and husky, and contains about three-and-a-half per cent. less gluten, &c., than the European oats shown below it in Table III. The proportion of non-nitrogenous to nitrogenous matter in it, viz., 7.09 to 1, shows that, compared with the standard it contains a little too much carbonaceous matter, and would consequently require to have a small quantity of some grain containing a larger proportion of gluten, &c., added, in order to bring it to the point required. Of samples of Indian corn in a state suitable for my operations, I could only procure two. These, on the average, contain 9 per cent. of gluten, being nearly 2 per cent. less than American, but the chief peculiarity is in the small amount of fat found in these specimens; although this constituent must vary considerably in different samples, for Dumas and Payen procured 9 per cent. of a yellow oil from maize, whereas Leibig has stated 4 25 as the amount which he found.

We come now to a class of grains, the millets, which occupy a position second to none in the country, and which form the staple food of a larger number of the population than, perhaps, all the other cereals put together. At the head of the list of these stands the great Indian millet called *Bajra*, and which itself, with the usual adjuncts of a little milk, &c., forms the chief article of diet of a very large number. Compared with rice, it will be observed to be considerably more nutritious, containing about ten and a-half per cent. of gluten, and giving a proportion between the carbonaceous and nitrogenous compounds of from 7 to 7½ of the former to one of the latter, whereas the one of all those rices on the list most rich in gluten contains only about eight and a-half of that substance, and gives the proportion already so often referred to, as a little more than 9 of the non-nitrogenous to the nitrogenous,—thus involving the addition of a larger proportion of some pulse or extra nitrogenous substance to increase the proportion between the flesh-forming and heat and fat yielding constituents. The Millet *jowaree* stands next in order of importance, both on account of its intrinsic value, as well as of the numbers it chiefly supplies with food. A glance at the table will show how it stands with reference to the last mentioned as well as to rice, and will save the tediousness of repeating in almost the same terms facts that can be seen at once. With regard to the millet which very properly stands at the bottom of the list, viz., *Khang* or the *Eleusine coracana*. Its low nutritive power is at once seen, and the necessity for adding pulse, &c., in order to bring its important ingredients into proper proportion. This grain, in some districts, is looked upon entirely as a famine food, and only had recourse to in seasons of drought, when other crops are very defective. In some places, during ordinary seasons, as much as from 130 to 140 lbs. are procurable for a couple of shillings.

We have next to consider rice, which is supposed to feed a larger number of the human race than any other grain, but, as already pointed out, rice is not employed alone to support animal life, and, indeed, the attempt to do so could not be otherwise than attended with failure, unless the stomach of the native had been made about exactly twice as large as it is, and his system endowed with extra capacity for getting rid of a very large quantity of superfluous carbon.

Rice is very largely employed, and certainly is a most important article of diet, but its chief property, in one sense, may be called negative. It plays the part of a diluent to highly nitrogenised compounds, and affords the bulk which seems essential to the formation of a wholesome diet. Rice is, therefore, rarely eaten alone; and when it is so, only from compulsion, as occasionally amongst some of the poorest classes in Arracan and adjoining districts.

Viewed with reference to the wants of the system, it will be observed that the proportion of carbonaceous matter to plastic, which it contains, is nearly twice as great as it ought to be. In order to afford, from my own laboratory, the means of comparing it with others, the vaunted Carolina rice has been subjected to analysis, and the result is that, as may be seen in the table, in point of plastic power it would have stood at the top of the list, but for the Bengal variety of rice, called *Bansmutti*.

Next to the Carolina rice comes a specimen of Java rice, which, in point of nutritive power, is within a fraction of its American brother; and, although its physical properties, also, are such as barely to permit of its being distinguished from the Carolina, its average price in the market here is several shillings per cwt. less than American cleaned Carolina, or nearly one pound less than British cleaned ditto, a little extra manipulation in this country costing some 15d. per cwt, and, even then, only a practical eye can tell the difference.

Of the "starches," embracing arrowroot, sago, &c., little need be said. A glance at the tables shows that, in these articles, nutritive power is at its minimum, as far as the plastic wants of the system are concerned. The plantain meal mentioned contains much more than any of the others in that part of the list, but, even it, in nutritive power, is not far from being one-half less so than rice, containing as much as 18 per cent. of carbonaceous to nitrogeneous matter.

We shall now shortly turn our attention to the pulses. From considerations already adduced, we have held that the nutritive value of these must be calculated not in accordance with largeness in amount of nitrogenous matter, but in proportion to relatively diminished quantity. From this, as already mentioned, it follows that the *Cajanus Indicus*, the favourite pea of the country, and the *Cicer arietinum*, or "gram," the chief food for our horses, and often of man, too, are precisely those in which the proportion of carbonaceous to non-carbonaceous is highest.

According to this showing, the *Cajanus Indicus* stands first, and gram next;—then follow the Dolichos beans, the next in favour, too, as articles of food; then we have various Phaseoli, and the *Ervum lens*, and lastly, common peas, which seem to contain the largest quantity of nitrogen, and which, therefore, demand an extra quantity of carbonaceous matter in order to obtain the standard mixture of six to one.

Experience has thus pointed out the two substances of this class most suitable as articles of diet, and I believe that their introduction into this country will prove of great use. There are many cases in which an easily digested pulse would prove of great service, and it will probably be found that these two ground into flour will in point of efficacy far exceed the Egyptian lentils, for which in various forms the public has to pay so much.

Gram is the great horse-food of the country, and I believe that, used along with a fair proportion of hay, &c., as a diluent, there does not exist in any country an article for such a purpose of equal value. In the form of "doll" it is parched, and on the voyage, or under circumstances which prevent, (according to his view,) legitimate cooking operations being carried out, it forms almost the entire food of the Sepoy.

These pulses, in varying proportions, are cultivated throughout the whole of India, and their importance, as constituting the chief source that furnishes the plastic or muscle element to a very considerable portion of the inhabitants, cannot be overrated.

For the present neither the time of the meeting nor the usual limits of the Society's *Journal* will permit me to enlarge much longer on this division of my subject. There still remain points of special information which I should like to touch upon, and accordingly a short appendix to this paper will appear in a subsequent number of the *Journal*.

Before concluding, there are, however, two vegetable products which these analyses bring out in strong relief, and show to contain a very large amount of important elements. The first of these is the *Soja hispida*, called *Bhoot* by the natives, and which I find to contain the enormous quantity of upwards of 46 lbs. per hundred of nitrogenous matter, nearly 12½ pounds of oil or fat, about 13 ounces of phosphorus, one ounce and a-quarter of sulphur, and equivalent to nearly half an ounce of iron.

With regard to it, I have been able to obtain but little general information. In Simmond's work on the commercial products of the vegetable kingdom, it is referred to as the source of the well-known "Soy sauce," but if it could be grown and procured in quantity, as an addition to other food, it probably, for feeding purposes, would be found to exceed in value that of any vegetable substance now known.

The other product, to which I would briefly refer, is marked as having come from Sumatra. It bears the native name of *Cutjang tahoo*, and is probably a Dolichos bean, like the former.

Of it I have, likewise, been able to obtain only meagre information. In Mr. Simmond's work, a leguminous plant is mentioned, which furnishes, on pressure, a residuum known under the name of *Tanping*, and which, in the form of a dry paste, is brought to Shanghai, in a quantity amounting in value to two and a-half millions sterling. This last fact is stated on the authority of the Rev. Mr. Medhurst, of Shanghai, and Mr. Thoms, British Consul at Ningpo. The bean referred to is stated as being imported into China,—pressed for its oil, which is used both for eating and burning, and the residuum, in form like large cheeses, is said to be distributed about China in every direction, and used as food for pigs and buffaloes, as well as for manure.

Although I am not in a position positively to state that the bean which I produce this evening is identical with that referred to, still its composition leads me to infer, that if not the same article, it is one perhaps equally worthy of the attention of the agriculturists of this country. On analysis, I find that it contains per 100 lbs. weight, 39.39 lbs. of nitrogenous matter; 17 lbs. 12 ozs. of oil or fatty matter; about 9½ ozs. of phosphorus and nearly two of sulphur.

There are many other special points of interest connected with the subject which I have attempted to bring forward this evening. These, however, must remain for another opportunity.

DISCUSSION.

The CHAIRMAN said he was sure the Society of Arts felt much indebted to Dr. Watson for having given them the benefit of his recent labours. Dr. Watson had been engaged by the East India Company in investigating some of the principal varieties of the food grains of India. At a later period of the evening he (the Chairman) would make a few remarks upon the chemical part of the subject, but at present he felt it would be presumptuous in him, in the presence of one who had devoted so much attention to the vegetable produce of India, and who could give so much information on that subject, to venture to lead the discussion in any way; he would, therefore, call upon Dr. Royle to favour the meeting with his remarks upon the paper.

Dr. FORBES ROYLE, F.R.S., said, the subject was of great importance, and of great interest to himself, and was, moreover, one upon which there was but little information which could be depended upon. He congratulated the Society and the public upon this exact determination of a number of facts hitherto unascertained. He entirely agreed with the author of the paper in repudiating the idea which had generally prevailed in this country that the natives of India lived for the most part on rice. It was only in particular places, in some of the deltas, that rice formed the staple article of food, and it was then mixed with ghee or butter. The principal articles of food throughout India, were the cereals and pulses of which mention had been made, and an interesting point with regard to these was that the climate enabled them to obtain two distinct crops in the year; one, the rainy season crop, and the other the cold season crop. There were, therefore, large quantities of nutritive diet, cereals as well as pulses, all over India, although, from a deficiency of rain in some parts, the crops would occasionally

be materially affected. Dr. Watson had called attention to the nutritive nature of the *Cajanus Indicus* and the *Gram*. In the north west provinces of India, sheep were fattened for the table upon the *Gram*, and the meat was of the most nutritious character. With reference to oats, the specimen which had been analysed was an unfavourable one, having been sent to this country in 1851, from Patna, the lowest part of the province where oats were cultivated. In the north-west provinces, where horses were bred, better oats were grown, and formed a nutritious food for those animals. In the hill districts barley of fine quality was grown, and some of the finest kinds of wheat were cultivated in the neighbourhood of the Nerbudda. Professor Solly had made analyses of both the hard and soft wheats of India, and at that time, wheat being dear, the samples sent over were valued at 105s. and 100s. per quarter—5s. per quarter more than the highest price of English wheat. The white wheat was least esteemed by the natives of India, the hard wheat being considered the most nutritious. He did not know whether chemical analyses bore out the native opinion in this respect. He could not but congratulate those connected with the Exhibition of 1851, upon the results accruing from the collection of so many materials of food from all parts of the world, especially from India. Many specimens of the grain analysed by Dr. Watson were collected on that occasion, and were found still to be in an excellent state; and the remarkable pulse, to which he had drawn attention, was one of those upon which it would be desirable to obtain further information, for, he believed, it might become an important article of commerce, when its valuable qualities were better known.

Mr. RIDDELL had resided for a long time in India, and was acquainted with almost every kind of grain produced there. He would corroborate the statement, that rice certainly did not form the chief article of food of the natives, although it was to be found in almost every part of the country, and there were no fewer than between 70 and 80 species of rice shown at the Madras Exhibition. The natives themselves used the commonest descriptions of it for their own eating, the finer qualities being reserved for the rich man's table, and the growers seldom tasted of their own produce. That rice, itself, was not so nutritious as many other grains, could not be doubted; but, when mixed with some of the vegetable products now before them, he believed it formed as nutritive food as wheat itself. Indian wheat ground into flour would not keep good for any length of time, and hence the bread and biscuits made in Calcutta for the navy were manufactured from newly ground wheat; indeed, the European and Cape samples were preferred to those of native growth. He had found that wheaten flour, kept in the best possible way, became mouldy in three or four weeks, and, for that reason, the natives and bakers always used it fresh ground. In the district of the Nerbudda, he had seen wheat growing in such quantities that there was not sufficient population to eat it and it remained on the ground. If means of conveyance to the coast could be obtained, they would have large quantities of wheat for exportation. He would mention, with regard to the gram, that he planted some in June last, soon after his arrival in England, which had produced as fine seed as any he had seen in India. With reference to the Dolichos, his idea had been that it was cultivated in England, and he had heard that in this country they manufactured soy from it. He believed that Indian beans, and many other seeds of great value, might be successfully cultivated in this country. With reference to the larger descriptions of millets he could say nothing, except that they were very prolific, and found to be highly nutritious diet, judging from the healthy appearance of those who used them. Spices and other condiments appeared to increase the nutritive qualities. With reference to Indian corn—the large corn—there were two kinds grown, one of which he had himself seen bearing on one stem seven or eight large heads, some of which produced as many as 500 seeds. The colours of this grain were yellow, red, and white. That it was a highly nutritive food there could be no doubt. Man thrived well upon it, when it was eaten either boiled or roasted; and cattle were fed upon the stems, which contained a large quantity of saccharine matter.

Mr. P. L. SIMMONDS said that his name having been mentioned by Dr. Watson in his paper, he might be permitted to make a few remarks, the more especially as the subject of the paper was one of those which he had suggested to the Secretary some time since, as one on which it was highly desirable to elicit information. He was, therefore, glad it had been so promply responded to, and so ably dealt with. The analytical and chemical portion of the subject being that which had been chiefly discussed so fully, he would confine his observations chiefly to the commercial aspects. The consideration of the food grains and pulses of India, nay, even of the roots, starches, and fruits of the East generally, was of considerable importance, not only to the natives who produced them, but also to many of our colonies, which depended chiefly on them for supplies, and to the inhabitants of Europe. Although it was endeavoured to be shown that rice was not the only food of the natives of India, still it could not be denied that it formed the chief bread-corn of the East, and was the principal grain exported from India. Not only did it form an article of immense consumption in China and most parts of India, but it was shipped in large and yearly increasing quantities to the Straits settlements, our colonies in the Indian Ocean, to Australia, and to Europe. At least 3½ million bushels were annually shipped to Ceylon, to feed the 60,000 or 70,000 Indian immigrants who went there to labour on the coffee plantations; 60,000 or 70,000 bags a month were also required for the Mauritius, besides large quantities of grain for the Coolies employed on the sugar estates. With the extensive Chinese emigration now going on to Singapore, Malacca, Penang and Australia, in each of which there were probably 50,000 or 60,000 Chinese located, and the number yearly increasing by thousands, there was necessarily a large demand for rice for a population otherwise engaged in producing sugar, spices, and other staples, and not producing food-grains. Our own imports of rice were also largely on the increase, for we could depend on receiving but a very small supply of the choice rice from Carolina, which had been alluded to by Dr. Watson. Slave labour was found to be more profitably employed on cotton, and the crops of South Carolina rice were therefore yearly declining. But unlimited supplies could be drawn from the East, whether of the superior Java rice, or of the more ordinary Indian qualities. While in the Irish famine year of 1847, we received but 588,708 cwt. of rice, and in 1853, but 1,504,629 cwt. of cleaned rice, and 19,500 qrs. of paddy, or unhusked rice; last year we imported 3,689,969 cwt. and 33,000 qrs. of paddy; about half of which was entered for home consumption. And this year, notwithstanding the commercial and political disturbances, the amount in the nine months of the year reached about 2,000,000 cwt. Rice, it should be remembered, entered into use, not only for food, but also for starch and the cotton manufactures, in aiding to form the weaver's dressing for warps, and for feeding stock. It had the advantage over most other grains, that it would keep good for years in its unhusked state, and for table use old rice was preferred to new. Owing to the wide extent of Indian territory available for rice culture, it was impossible for the grain crops to fail universally. Within the last 15 or 20 years, the province of Arracan had become the granary of a great part of India and Europe, and the rice garden of our eastern settlements. Increased land has been brought under culture, and the trade in produce had been steadily developed, until Arracan now competed with Bengal in the rice trade of the continent; and the exports, which in 1830 occupied only a few coasting vessels, in 1854 re-

quired more than 100,000 tons of shipping. The exports of rice from Akyab, which, in 1849, were only 65,000 tons, in 1853 exceeded 120,000 tons; while the Bassein district shipped 150,000 tons, making a shipment of 270,000 tons of food grain from one small quarter of the Arracan Province. Considerable quantities of rice were also shipped from Moulmein, from Tavoy and Mergui. From Madras the exports of rice in 1856 amounted to 118,334 Indian maunds (about 88.750 cwts.) From Calcutta the average exports were 200,000 tons a year, of which one-half came to Europe, one-fourth went to the Mauritius, and the remainder was shipped to Australia, North America, and other quarters. But in the paper they had just heard, various other important grains and pulse are enumerated; but these do not form a tithe of the food plants of India; and respecting the culture, yield, and comparative value of many of these, information was much sought, both in a scientific point of view and in the consideration of which of them it would be desirable to recommend the culture of in other quarters, such as in America and in our own colonies. This was a point to which his (Mr. Simmonds's) attention was often drawn, when in correspondence with foreign Agricultural Societies of which he was a member. One stumbling-block was the numerous vernacular names by which a particular plant or its grain was known in different localities in India. The native dialects were so numerous, and the name varied with the wet or dry crop, while the botanical name was so seldom given, that it was difficult to identify from the seed alone the numerous varieties of millets, and the pulses, passing under the common general name of Doll and Gram. This was a difficulty which he had met with in preparing the work on Vegetable Products which Dr. Watson had alluded to, for though he had been induced from the current interest of the food question at the time of publication, to devote a very large portion of the work to details connected with food plants, he had not been able to be so precise and accurate in his descriptions respecting the Indian grains and pulses as he could have wished. Some ten or twelve years ago he had endeavoured to diffuse information on the agriculture of Hindostan in a series of papers published in his *Colonial Magazine*, and although the subject had not then the importance with which it was now invested, still it had enabled him, in connection with the fine collection of grains shown at the Great Exhibition, the reports of the Madras Exhibition, and a study of Col. Sykes's observations on the cerealia of India, to master many of the difficulties which had previously stood in the way. A little work, on which he had been for some years engaged, a dictionary of trade products, which he hoped would be published in about a month, would probably be found useful to many, for in it the various names would be given under which different grains and pulse were known in the various districts of the East. With respect to the leguminous plant alluded to in his work, cited by Dr. Watson, he had not yet been able to obtain any definite information respecting it. At a meeting of the Society early last year, he had placed on the table, with numerous other specimens of grains and seeds, some of these large white Chinese peas from Shanghai, and which formed so large an article of commerce there. From the appearance of the pulse it certainly was not a Dolichos. That from Sumatra, shown to night, judging from the analysis of Dr. Watson, was well worthy of extended cultivation. Mr. Simmonds added that he had found no difficulty in raising varieties of Doll and Gram in his greenhouse, if sown at the proper season. Dr. Watson had stated the value of the whole of the grain exports of India at £889,000 for 1853. He thought this a very low estimate, looking at the statistics which he had cited of the rice exports alone, exclusive of other grain and pulse. Probably this arose from a very low official export value in the Customs records. The food resources of India, its capabilities of supplying home and export demands, connected as they would be with the cheaper transport to the towns and coast, arising from improved land and water communication, and greater facilities afforded to colonization and land settlement, were questions of the highest importance to India, to the adjacent colonies, and to Europe.

Dr. Royle said that the details of every one of the grains, alluded to by Mr. Simmonds, would be found in Dr. Roxburgh's Flora Indica as the result of examinations made at the beginning of the present century. In that work he believed every species of grain known in India was botanically treated of, as well as the mode of cultivation which each required.

The Chairman said, there was one point upon which he was sure the meeting would like to hear the experience of Indian gentlemen,—several of whom he saw present—that was, as to the influence which the various kinds of food throughout India exerted upon the character of the population. In the narrative of the recent travels of Dr. Livingstone it was worthy of observation that the character of the nations through which he passed depended upon the habits of the people in the acquisition of their food, as well as upon the food itself. For instance, the Kaffirs, who lived by hunting, and were flesh eaters, were wild and warlike. Then there were the Wampoos, who lived principally on grain, and were of a more quiet and peaceable disposition; then, again, there were the Bituanoes, who lived upon grain, were more civilised than the Kaffirs: and again, the Macololas, who combined as their food both grain and flesh; they did not lose the warlike character, and made incursions upon their more feeble neighbours. It was an axiom amongst the latter people that if it were not for the gullet (alluding to their appetites) there would be no war or fighting amongst mankind. In those parts, such as Loando, where the people lived upon starchy varieties of food, they had become diminutive in their stature, and this applied, not merely to the natives, but also to the Portuguese settlers there, for they had lost the physical characteristics of their ancestors, and had become feminine in their frames and habits; and this extended even to their handwriting. Where more nitrogenous food was taken the physical character of the people had not undergone that very marked change. It had been calculated that there must be thirty-six ounces of nitrogenous matter per week in the food of a man to make him fight. The Dutch soldiers in time of peace were allowed twenty-two ounces of nitrogenous matter, but they could not fight upon that; when required to fight they were allowed 36 ounces of nitrogenous matter per week. It would therefore be most instructive to hear what were the habits of the different nations in India with reference to their food—not merely the proportion of nitrogenous matter, but the amount of real flesh taken with their grain food. He felt quite confident that the Ghoorkas, those brave little warriors who had so much distinguished themselves during the late rebellion in India, partook of a large amount of nitrogenous food. He hoped Dr. Watson would discuss this interesting subject in his next paper, inasmuch as accurate data upon that point were very much wanted. As yet they had not sufficient to judge of the full effect of food upon the different races—not only as regarded the question of the food itself, but as to the mode of acquiring it, which also had an effect upon the character of a people. In illustration of this, he might take the people of Ireland. If they had a population depending upon a certain quality of food in which carbonaceous matter had an undue proportion to the nitrogenous matter, certain results must follow. In the first place, the wages of labour could not be high, and the state of the country must be low as long as the people continued to live upon such a character of food. Before a man could compensate for the expenditure of muscular power consequent upon a day's hard labour, he must eat from 14 to 15lbs. of potatoes; this was, in fact, impossible. A

man could not take more than 7lbs. of potatoes per day, and a woman 5lbs.—their bodies could not contain more. Therefore the labour so sustained was only half the value of that of the wheat-eating men of this country, who also ate flesh and labour-producing matter. Give an Irishman potatoes in this country, and an Englishman wheaten food, the very character of the diet would make the former worth only half the wages of the latter. It was the nitrogenous and flesh-forming matter which, in the competition of labour, gave the superiority to the English workman. But as he had before remarked, it was not only the description of the food itself but the habits of procuring it, that constituted the difference of the physical characteristics. When the Irish depended chiefly upon potatoes their labour was called for only twice in the year, namely, at seed time and harvest. During the rest of the year they had nothing to do; and, therefore, labour, instead of being steady and continuous was impulsive. In point of fact, the famine in Ireland was one of the greatest blessings that could have befallen that country. It caused them to depend less upon what had hitherto been the staple food of the people, and which had kept wages low and rendered labour impulsive: and it created a demand for other kind of food in order to avert a potatoe famine for the future; and thus labour became distributed over the year to the benefit of the Irish people as well as of this country. He would now say a few words with reference to the chemical part of the subject. Perhaps a little too much stress had been laid upon the nitrogenous theory of food. Liebig had shown them what the nitrogenous matter of food was, and the functions it performed in the building up of the frame-work of the body. The non-nitrogenous kept up the respiration and heat, but was not used in the construction of the frame-work of the human machine. Knowing therefore the discoveries of Liebig, and his process of thought during the time that those discoveries were made, from a constant correspondence with him at that period, he (the chairman) in lecturing upon those views had never intended to represent Liebig as saying that unless there was a due balance between nitrogenous matters and carbonaceous matters, the proper nutriment of the human frame could not be carried on. The case was just this—supposing they had a machine at work; it required iron for the frame work, coal for fuel, and steam for motive power. The machine could not do with any one of these elements alone; and if repairs were required, they must be effected with the same material as that whch had been expended. They could not repair the iron frame with coal; they must use the same description of material. In like manner, the views of Liebig were that the nitrogenous matters were the nutritive matters of the machine, which formed the basis of our bodies, and the other materials, the non-nitrogenous matters, kept up the great functions of the body, producing not only vital heat, but the powers necessary to the action and motion of the machine. Dr. Watson had done great service to science by insisting upon a due proportion between the non-nitrogenous substances and the nitrogenous, but he (the chairman) did not quite agree with him as to the exact proportions of the two. Let it be taken that the proportion of flesh-forming ingredients to non-nitrogenous should be as 1 to 6, that would be only a rough approximation; for this reason—the non-nitrogenous matters were varied in their composition, whilst the flesh-forming were nearly always the same. It was of small consequence whether the flesh-forming matter was derived from one ingredient or another. Thus, in a hunt, they had an omnivorous man, mounted upon a graminivorous horse, accompanied by carnivorous dogs, pursuing a vegetable-eating hare or a flesh-eating fox. Therefore, whether the non-nitrogenous matter was got from vegetable or animal element, was indifferent. But it was not so with regard to the heat-giving matters. There was one point which was especially perplexing to chemists—that was as to the quantity of fatty matter that was used in the food of people of hot climates, such as India. They could readily understand why fatty substances were largely consumed by the people of the Arctic Regions, in order to supply the fuel to keep up the bodily heat in cold climates, but with regard to India it was more difficult of comprehension. He (the chairman) thought that it might possibly serve to prevent the too great perspiration of the body, as they found in tropical climates it was the custom to smear the body with oil, to prevent the too rapid withdrawal of water from the system; and if the people partook of oleaginous matter it might possibly have a similar influence.

Dr. Royle said, when he was in the North-Western Provinces, he saw a good deal of the Ghoorkas, and he could state that in their habits of living many very nearly approximated to the European. They were fond of field sports, and were good marksmen with the musket, eating the game they shot, together with vegetable diet.

Mr. J. Griffith Frith, in adverting to the statement that wheat imported into this country from India was of little value in the market, mentioned that he had known that wheat to be sold at a very high price. The great evil with regard to the Indian wheat was, the presence of the weevil, in some cases to such an extent as to render the wheat almost valueless. He wished to inquire whether the hard or soft wheat was most subject to the attacks of that insect.

Dr. Royle remarked that, at present, entomologists were at a loss to account for the manner in which the insect got into the wheat. On the occasion of Professor Solly's analysis of wheat from the Nerbudda, the presence of the weevil was detected to a considerable extent. On examining the wheat under the microscope, small appearances were noticed, which seemed to indicate that the insect attacked the wheat in a growing state, but at what stage he was unable to say. The opinion of some entomologists was, that the wheat was attacked by the weevil when deposited in the granaries. Others were of opinion that the ova were deposited in the growing grain. Wheat had been sent from India to Australia without being attacked by the weevil.

Mr. Philip Palmer said, now that they were sending large bodies of troops from this country to India, it was important to know what effect, upon the constitution of Europeans, the use of these different grains as food would have. Each province of India had its peculiar food; and as they had been told by the learned chairman that a certain quantity of food was necessary for the performance of a given amount of labour, it became a matter of interest to know how their countrymen, now going out to India, would fare in that respect, and what description of food would be given them.

Dr. Watson replied that the food supplied to the soldiers in India did not differ materially from that to which they were accustomed at home. About the same proportion of flesh was allowed. However, he thought, if Europeans assimilated their diet more to that of the natives it would be beneficial to them.

Mr. Riddell mentioned that when in India he had always understood that considerable quantities of wheat were exported to England. At the same time, he believed it would be found that this was only the case when that commodity was fetching a very high price at home, for he was of opinion that the Indian was not worth more than two-thirds of the value of English wheat. That it was wanting in the nutritive power possessed by the English grain there could be no doubt. He thought one reason for this was the difference in the length of time in which the grain came to perfection. In India the wheat was sown after the rains, and three months afterwards it was reaped. Until means of communication were opened in India, from the interior to the coast, it was not worth while to export wheat. Indeed, in many parts of the country where wheat was most plentiful, even if it could be obtained for nothing, the expense

of conveyance to the coast would be so great that it would not be worth the cost of carriage.

Mr. THOMAS SCOTT remarked, that in a country like England, where they had the fullest means of selecting the diet which they preferred, the elaborate research which they saw before them in the tables now exhibited might appear a useless work; and he had heard the same remark applied to the able paper of Dr. Letheby on a similar subject read last session. It, however, must be admitted that the results obtained were most important. But, leaving man out of the question for the moment, and taking the various articles applicable to the food of domestic animals, they had, by inductive reasoning, arrived at the most invaluable results. Thus, in the feeding of animals they now were able to supply the food in the first instance which contained the elements for building up the frame of the growing animal, and afterwards food containing different elements for the fattening of the mature animal. Again, with regard to vegetable physiology, they were all aware of what had been done by Liebig as to the management of the feeding of plants. It was scarcely necessary to follow out the argument of the learned chairman that the character of a people was regulated by the food on which they lived. He (Mr. Scott) had employed many hundreds of Irish labourers, and when they arrived here, and took a different kind of food, their labour, which was worth only 10d. per day in Ireland, was worth 3s. 6d. in this country and was, moreover, more profitable to their employers at the higher than at the lower sum. The famine in Ireland had created an entire revolution in the domestic and social economy of that country. They ceased to regard the potatoe as the staple article of food. A demand upon the labouring population was made, and the character of the agriculture of the country was altered. It was now the case that almost everywhere the people sold their potatoes, as well as the whole of their oat crops, with but few exceptions. The better class of labourers used to eat oatmeal, but now they took maize, because it enabled them to work better. It was desirable to feed the labourer with food that was proper for the demands made upon his muscular energies; but it was necessary, in the first place, to create a taste for that food.

The CHAIRMAN said, in proposing a vote of thanks to Dr. Watson, he could not avoid expressing his opinion that it was most important for the interests of India that this investigation should be further pursued. Dr. Watson had only got a certain way, although it was astonishing the amount of work he had accomplished in the few months during which he had been employed in these researches. It would be a great boon to India to continue the experiments so well begun. It was not always the case, that if the palate appeared to indicate that certain things were suitable, they could always follow the dictates of nature, because large bodies of men had no choice of food. This was especially the case with soldiers and sailors, and in our workhouses and prisons. Large masses of the people lived upon dietaries arranged by government, and there never was a more remarkable instance of the effect of a want of knowledge of these subjects—than was shown in the dietaries of our prisons, where men received an amount of nitrogenous matter in their food, varying according to the periods of confinement, and not according to the work that they had to perform in prison. The arrangement of dietaries by government ought to be made according to the last discoveries of science. Although there were still difficulties in the question, they knew sufficient to regulate those matters much better than was done at present. He hoped Dr. Watson would receive encouragement from the public, and from the East India Company, to continue these valuable researches, and that he would not find it necessary to give up so useful an inquiry in order to attend to his military duties. He begged to propose a vote of thanks to the author of the paper.

A vote of thanks to Dr. Watson for his paper was then passed.

In returning thanks, Dr. WATSON said there was one fact mentioned by Mr. Riddell, of the greatest importance—namely, the successful cultivation of the gram in this country, which in course of time might supersede the various expensive products now received from Egypt. He thought the hint thrown out by Mr. Riddell ought to be taken advantage of, as he felt confident an admixture of the gram with other food for horses, would produce a better diet than was at present used.

The Secretary announced that on Tuesday evening, the 1st of December, at seven o'clock, a Special General Meeting of the Society would be held, to which Members only would be admitted, and that at the Ordinary Meeting on Wednesday evening next, the 2nd of December, a Paper, by Mr. Apsley Pellatt, "On the Relative Heating Powers of Coal and Coke, in Reference to Economy in Fuel and the Smoke Nuisance," would be read.

SILVER IN SEA-WATER.

BY PROF. S. BLEEKRODE.

In the early part of this year Professor Faraday related to the Royal Society the experiments of Mr. Field respecting the presence of silver in sea-water. That silver could be detected in sea water had already been shown by Malaguti, Durocher, and Sarzeau. Their calculation was that it contained 0·00000001 per cent. They detected one milligramme in a hundred litres of salt water from the canal at St. Malo, and also in the ashes of seaweeds: in the *Fucus serratus*, 0·00001, and in *Fucus ceramides*, 0·00000001 per cent. of silver.

From the solubility of chloride of silver in chloride of sodium (sea salt), Mr. Field suggested that the silver in that form was dissolved in sea-water, and would be deposited upon copper or yellow metal by the known galvanic reaction. He also observed that that would be likewise the case with the sheathing of ships. Mr. Field analysed 5,000 grains, and found in one case the amount of silver to be 10oz. 2 dwt. 15 gr. Tr. per ton, or 35·326 grains per 1,000 kilogs., and in the other 7 ozs. 13 dwt. 1 gr. Tr. per ton, or 238·006 grains per 1,000 kilogs. I have analysed two different portions of yellow metal, being the worn-out sheathing from Dutch ships in the East Indian trade. The quantity analysed was 1 kilog. (= 2 lbs. 8 oz. 3 dwt. 0·3 gr.) in both cases. The result was:—341 grains per 1,000 kilogs., and 271 grains per 1,000 kilogs. The amount of silver will not be constant, because the sheathing is covered with sand, lime, and other materials, and these cannot be separated without some chance of loss. This communication may possibly confirm the observations of others.

SMOKE CONSUMING FIRE-PLACE.

A smoke-consuming fire-place for ordinary purposes in dwelling houses has been invented by M. Touet Chambor, of Paris. The fire-place consists of a plate of cast iron, bent over at the top at one-third of its height, and surrounded by an iron frame similar to that employed in ordinary fire-places. Attached to this is a cast-iron basket, in which the fuel is placed. The back of this basket is furnished with vertical bars, through which the products of combustion pass into a chamber in the chimney at the back of the grate, the fuel burning with a descending current and the smoke being thus burnt or consumed. In the chamber at the back of the grate is placed a system of tubing, one end of which communicates with the open air, the other with the room to be

warmed. The heat from the fire, being conducted over this tubing, warms the air in its passage through it into the room. At the back of the vertical bars an iron plate slides up and down, so as to regulate the amount of opening into the chamber at the back and thus increase or diminish the draft. In the upper and bent portion of the iron plate are two openings into the chimney with sliding doors or registers. These registers, in conjunction with the sliding plate at the back of the fire-place, assist in regulating the draft through the fire and over the tubing. By lowering the sliding plate and opening the register above, the grate becomes at once an ordinary open fire-place, the flame and smoke ascending through the chimney in the usual way. By closing the upper register, partially or wholly, as may be found necessary, and raising the sliding plate, the action of the draft becomes at once reversed, the smoke is consumed, and in addition to the radiated heat from the open fire, the play of the flame and heated gases on the tubing causes warm air to pass into the apartment. This tubing, from its size and length, and the continued flow of cold air through it, is kept comparatively cool, and though made of thin sheet iron is stated never to get over-heated, and is thus preserved from destruction. The fire-place is adapted to burn wood, coal, coke, and every variety of fuel. It is not easy to give a very intelligible description of this fire-place without diagrams, but if any member of the Society desire further information, the Secretary will be happy to place them in communication with M. Touet Chambor, who is now in London, and will show the stove in action.

Proceedings of Institutions.

MACCLESFIELD.—The twenty-second annual meeting of the Useful Knowledge Society, was held in the Town-hall, on Tuesday evening, Nov. 10, when prizes were awarded to the most successful students in the various classes. Samuel Greg, Esq., one of the vice-presidents of the Society, occupied the chair, in the absence of the president, J. Brocklehurst, Esq., M.P. On the platform were—the Mayor (F. Jackson, Esq.), the ex-Mayor (W. Bullock, Esq.), C. Egerton, Esq., M.P., Rev. W. C. Cruttenden, Rev. W. R. B. Arthy, Joshua Fielden, Esq., of Todmorden; Mr. T. U. Brocklehurst, Mr. C. Brocklehurst, Mr. John May, and Mr. Potts. The room was well filled. The Chairman, after addressing the meeting, called upon the Honorary Secretary to read the report of the Committee. One of the first subjects to which their attention had been drawn after their election to office, was a revision of the rules of the Society, and in the performance of this duty the Committee availed themselves of all the information they could obtain from the rules of similar Societies in other towns, and they have thus been enabled, after much labour and mature consideration, to frame and submit to the members a new set of rules and regulations, which they believe are applicable not only to the present position of the Society, but also to any varying circumstances which may hereafter arise. The Committee much regret that the readings and lectures during the past year have been so scantily and poorly attended, and that they have therefore been obliged to decline making any new engagements with lecturers. The classes, however, continue to be well and diligently attended, and the progress of the pupils, both male and female, (as is shown by the teachers' reports,) has been and is still most satisfactory. With respect to the library, the Committee report that they have increased it by the purchase of about 200 volumes, in addition to several donations. The number of volumes issued during the past year has been about 12,300, and in this issue, the more solid and instructive works have borne a just proportion. The Committee have much extended the utility of the News and Reading-rooms by the introduction of additional newspapers and periodicals. Special thanks are due to E. C. Egerton, Esq., M.P., for a donation of £50, which, with another £50, part of the last year's balance in the hands of the Treasurer, has been applied in reduction of the debt on the Society's premises. The Committee also thank Mr. Egerton for a donation of £5 5s. for prizes for the pupils, and for his promise of annually repeating this donation. After the reading of the report, Mr. Egerton addressed the meeting, and was followed by Mr. T. U. Brocklehurst. The distribution of the prizes to the successful students then took place, the Chairman and Mr. E. C. Egerton taking part in the proceedings, and addressing a few words of commendation and encouragement to the several recipients. The reports of the class teachers were then read, which shewed that the classes had been largely and diligently attended. The meeting was afterwards addressed by Mr. Greg, the Mayor, Mr. John May, the Rev. W. R. B. Arthy, Mr. Joshua Fielden, the Rev. W. C. Cruttenden, Mr. Potts, Mr. Charles Brocklehurst, Mr. Wright, Mr. Bullock, Mr. Jesper, and Mr. Curwen. After passing the usual votes of thanks the meeting separated.

NAILSWORTH.—The present session of the Literary and Mechanics' Institute was inaugurated by a soirée, which took place on Tuesday, the 13th October, at the Nailsworth Subscription Rooms. Mr. J. E. Barnard, who has been president of the Society from its commencement, having resigned that post, the opportunity of the opening festival was taken to present him with a testimonial,—a handsome silver inkstand, subscribed for by the whole body of the members. M. H. Whish, Esq., the President of the Institute, occupied the chair; and the room was well filled. The Chairman commenced by referring to the loss of Mr. Barnard as their president, and to the removal from the neighbourhood of one of their most active supporters, Mr. Anstie. They had to congratulate themselves on the fact that though the novelty of the institution had passed by, yet the Society still held its own. It was very much the case that institutes which flourished at first, languished after a little time when their first and principal supporters died and fell away; but they had kept on very well, and had more than balanced their expenditure by their receipts. It was a matter of satisfaction that several gentlemen and ministers of the neighbourhood had given them their countenance, and favoured them with lectures. Mr. Sibree was then called upon to address the meeting. Mr. Whish had put into his hand a subject on which to speak,—Free Discussion—its influence on the national character. He feared that an important branch of their Society—the discussion class—was not in so vigorous a condition as formerly. Free discussion had an important influence on the national character. Without the discussion of principles, no great advance would be made in any branch of knowledge. It had been said that man is naturally a contentious animal, and Hobbes had affirmed that the natural condition of mankind is war. He believed that to a certain extent that was true, though it should be a war of discussion, of opinion,—that war whose issues are in truth, and in all the great advantages which are connected with truth. Free discussion might be conducted with very little profit, for discussion should always be founded upon knowledge. It ought to lead to knowledge, and if it did not, it was of comparatively little value. Referring to the Indian question, he thought that the members should more especially cultivate those branches of knowledge connected with that subject. There would come a time—and that not far distant—when the subject would be thrust upon their attention, and they would have many facilities during the winter to study its bearings and interests. In presenting the testimonial to their late president, Mr. Bruton referred to the past history of the Institution. He remarked that those who had invested money in the building ought to be satisfied with the happy sight they then and at other times witnessed, and

accept that as a sort of interest for their investment. He concluded by referring to the great services that Mr. Barnard had rendered to the Institution. That gentleman then returned thanks, and said their success was mainly attributable to the unity and cordiality always exhibited amongst the members of the society. The meeting was afterwards addressed by the Rev. E. N. Maugin, Mr. Lycett, Mr. W. Barnard, and other gentlemen, and concluded by passing a vote of thanks to the Chairman.

MEETINGS FOR THE ENSUING WEEK.

MON. Royal, 4. Anniversary.
Actuaries, 7. Mr. Willich. I. "On a New Formula for the Expectation of Life." II. "On the Value of Life Annuities yielding a given Rate of Interest, the Capital to reproduce the Purchase Money being invested at another Rate."
Architects, 8. Mr. W. A. Boulnois, "On the Foundations of some of the Metropolitan Bridges in the River Thames."

TUES. Society of Arts, 7. Special General Meeting.
Civil Engineers, 8. Renewed discussion on Mr. Molesworth's Paper, "On the Conversion of Wood by Machinery;" Mr. T. S. Sawyer, "On Self acting Tools for the Manufacture of Engines and Boilers."
Pathological, 8.

WED. Society of Arts, 8. Mr. Apsley Pellatt, "On the Comparative Heating Powers of Coal and Coke, in regard to Economy of Fuel and the Smoke Nuisance."
Geological, 8. Mr. H. D. Sorby, "On the Structure of Crystals, as applicable to the Determination of the Aqueous or Igneous Origin of Minerals and Rocks."

THURS. Zoological, 3.
Antiquaries, 8.
Chemical, 8. I. Dr. Muller, "On Rosolic Acid." II. Mr. F. Field, "On the Arseniates of the Earths."
Linnean, 8. I, Mr. Garner, "On the Shell-bearing Molluscous Animals, particularly with regard to Structure and Form." II. Mr. Cobbold, "General Observations on *Entozoa*, with notices of several new species, including an account of *Tænia serrata* and *T. cucumerina*." III. Mr. Sclater, "On the Fauna of New Guinea."
Philological, 8.
Photographic, 8.

SAT. Asiatic, 2.
Medical, 8.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, November* 20.]

Dated 5th October, 1857.

2552. James Coombe, Belfast—Improvements in machinery for hacking and preparing flax and other fibrous substances.

Dated 16th October, 1857.

2648. David Guthrie and Joseph Vavasseur, New Park-street, Southwark—A machine for cutting, chipping, or rasping dye-woods or other similar fibrous substances, for the purpose of obtaining extracts.

Dated 21st October, 1857.

2686. Robert Clark, Glasgow—Improvements in effecting the consumption or prevention of smoke, applicable to steam boilers and other furnaces.

Dated 22nd October, 1857.

2694. Marc Antoine François Mennons, 29, Rue de l'Abbaye-Montmartre, Department de la Seine, France—Certain improvements in machinery for the preparation of peat. (A communication.)

Dated 24th October, 1857.

2708. James Thom and Hugh McNaught, Glasgow—Improvements in looms for weaving.

Dated 4th November, 1857.

2797. Richard Laming, Hayward's Heath—Improvements in purifying gas and in apparatus useful for that purpose.

2799. Francis Higginson, Woodlands-cottage, Woodlands, Hants—Submerging, extending, and laying down submarine, electric, magnetic, and every other description of submerged or immersed electrical telegraph cables, wire ropes, and combined wire, gutta percha, spun-yarn, or other compound electrical cables whatsoever.

2801. Romain Ignace Charles Dubus, Brussels—A method of treating certain plants or vegetable substances, in order to extract from the same, 1st, a kind of fecula or farina proper both for alimentary and finishing or starching purposes; 2nd, an alcoholic liquor; and 3rd, a natural ferment or yeast.

2803. Charles Clay, Walton, near Wakefield—Improvements in machinery for grubbing or cutting up weeds and otherwise scarifying and cultivating land.

2805. Joseph Miller, Alpha-road, Regent's-park—An improved arrangement of marine steam engines.

Dated 5th November, 1857.

2807. Joseph Bunnett, Deptford—Improvements in machinery for banding and shaping metals.

2809. George Robinson, High street, Deptford—Improvements in apparatus for shelling or hulling coffee and other berries and seeds.

2811. John James Cousins, Park-lane, Leeds—Improvements in the construction of steam ploughs.

2813. William Sharman, Sheffield—An improved metallic compound, applicable to the manufacture of useful and ornamental articles for which German silver and compounds resembling German silver are at present used.

Dated 6th November, 1857.

2815. Frederick Lipscombe, Strand—Improvements in the mode of conveying water and other liquids.

2817. Germain Canouil, Paris—Improvements in the manufacture of matches.

2819. Henry Bessemer, Queen street-place, New Cannon-street—Improvements in the manufacture of malleable iron and steel, and also in the manufacture of railway bars, and other bars, plates, and rods from iron or steel so manufactured.

Dated 7th November, 1857.

2821. Hugh Baines, Manchester—Improvements in machinery or apparatus for the prevention of accidents, applicable to hoisting and other lifting machines.

2823. John Henry Pepper, Royal Polytechnic Institution, Regent-street—Improvements in displaying various devices when revolving discs or surfaces are used.

2825. William Wilson, 1, Canterbury-place, Newington, and James John Joseph Field, 11, Sussex-street, Wandsworth-road—Improvements in casting or moulding liquified and other substances.

Dated 9th November, 1857.

2827. Walter Hardie, 6, Pitt-street, Edinburgh—An improved stereoscope.

2829. Pier Alberto Balestrini, Brescia, Italy—Improvements in machinery and apparatus for paying out submarine telegraph cables, and for regulating and controlling the paying-out thereof.

2833. George Weedon, Gloucester-place, Portman-square, and Thomas Turner Weedon, Plumstead—An improved knife-cleaning machine.

2835. John Reeve, 46, Rutland gate—Improvements in propelling vessels.

Dated 10th November, 1857.

2837. Thomas Rowcliffe, 26, Upper Park-place, Dorset-square—Improvements in machinery for making and pressing bricks, drain pipes, and tiles, and in preparing material to be used for such like purposes.

2839. Joseph Townsend, Glasgow—Improvements in the manufacture or production of sulphurous acid.

2841. John Thomas Way, Welbeck-street, Cavendish-square—Improvements in obtaining light by electricity.

2843. Henry Critchett Bartlett, Ampthill-square, Hampstead-road—Improvements in the manufacture of paper.

INVENTIONS WITH COMPLETE SPECIFCATIONS FILED.

2849. Edward Halliday Ashcroft, Massachusetts, U.S.—An improved mode of preventing the over-heating and bursting of steam-boilers. (A communication.)—11th November, 1857.

2879. John Gedge, Wellington-street South, Strand — Improved means for stopping or retarding carriages used on ordinary roads. (A communication.)—17th November, 1857.

WEEKLY LIST OF PATENTS SEALED.

November 20th.

1423. James Abbott, jun., Richard Handley Thomas, John Young, and James Edward Hunt.
1424. Joseph Jakens.
1434. William Todd.
1453. William Carron.
1458. Thos. Humphrey Roberts.
1459. Thomas Silver.
1460. Gautier Olivier de la Barre.
1461. John Phillips.
1478. William Scott Underhill.
1606. William Wright.
1634. Alfred Vincent Newton.
2230. Frederick Albert Gatty.
2508. Rudolph Bodmer.

November 24th.

1464. William Robertson.
1489. Robert Parkinson and John Standish.
1491. William Irlam Ellis.
1492. Henry Crompton.
1497. Jean Leonard Codet-Négrier.
1499. Randal Cresswell.
1502. Richard Archibald Brooman.
1509. Richard Edward Hodges.
1509. William Hale.
1515. Alexander Simpson.
1516. William Wilber.
1521. James Merrylees.
1555. James Stevens.
1562. William Jones.
1567. John Jobson.
1579. Richard Roberts, Wright Shaw, and Samuel Shaw.
1599. Alfred Jean Vincent Dopter.
1605. William Wright.
1630. Arthur Dunn.
1636. George Farrell Remfrey.
1642. Joseph Michell Paule.
1681. William Edward Newton.
1692. Salomon Sturm and Henry Emile Bour.
2182. Peter Carmichael.
2250. John Penn.
2265. Thomas Brown.
2292. Henry Rawson.
2407. Emile Alcan.
2451. Daniel Forrester.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

November 16th.

2433. William Low.
2442. George Tomlinson Bousfield.

November 17th.

2449. Edouard Belmer.
2451. Henry Diaper.
2459. William Beasley.

November 19th.

2496. Joseph Gillott, jun., and Henry Gillott.
2542. Joseph Maudslay.
2564. Albinus Martin.

November 20th.

2481. Samuel Alfred Carpenter.